

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone                 | Solar gain limit exceeded? (%) | Internal blinds used? |
|----------------------|--------------------------------|-----------------------|
| 01_A_Community_Space | NO (-75.5%)                    | NO                    |
| 01_B_Gym_WCs         | N/A                            | N/A                   |
| 01_A_Creche_core     | NO (-71.8%)                    | NO                    |
| 01_A_Creche_peri     | NO (-39.9%)                    | NO                    |
| 01_B_Gym_core        | NO (-82.2%)                    | NO                    |
| 01_B_Gym_peri        | NO (-56%)                      | NO                    |

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

|                                                                                        |    |
|----------------------------------------------------------------------------------------|----|
| Were alternative energy systems considered and analysed as part of the design process? | NO |
| Is evidence of such assessment available as a separate submission?                     | NO |
| Are any such measures included in the proposed design?                                 | NO |

## Technical Data Sheet (Actual vs. Notional Building)

### Building Global Parameters

### Building Use

|                             | Actual | Notional | % Area | Building Type                                             |
|-----------------------------|--------|----------|--------|-----------------------------------------------------------|
| Area [m²]                   | 519.2  | 519.2    |        | A1/A2 Retail/Financial and Professional services          |
| External area [m²]          | 353    | 353      |        | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways    |
| Weather                     | LON    | LON      |        | B1 Offices and Workshop businesses                        |
| Infiltration [m³/hm²@ 50Pa] | 3      | 3        |        | B2 to B7 General Industrial and Special Industrial Groups |
| Average conductance [W/K]   | 163.82 | 210.4    |        | B8 Storage or Distribution                                |
| Average U-value [W/m²K]     | 0.46   | 0.6      |        | C1 Hotels                                                 |
| Alpha value* [%]            | 10     | 10       |        | C2 Residential Institutions: Hospitals and Care Homes     |
|                             |        |          |        | C2 Residential Institutions: Residential schools          |
|                             |        |          |        | C2 Residential Institutions: Universities and colleges    |
|                             |        |          |        | C2A Secure Residential Institutions                       |
|                             |        |          |        | Residential spaces                                        |

\* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

|     |                                                                    |
|-----|--------------------------------------------------------------------|
| 100 | D1 Non-residential Institutions: Community/Day Centre              |
|     | D1 Non-residential Institutions: Libraries, Museums, and Galleries |
|     | D1 Non-residential Institutions: Education                         |
|     | D1 Non-residential Institutions: Primary Health Care Building      |
|     | D1 Non-residential Institutions: Crown and County Courts           |
|     | D2 General Assembly and Leisure, Night Clubs, and Theatres         |
|     | Others: Passenger terminals                                        |
|     | Others: Emergency services                                         |
|     | Others: Miscellaneous 24hr activities                              |
|     | Others: Car Parks 24 hrs                                           |
|     | Others: Stand alone utility block                                  |

### Energy Consumption by End Use [kWh/m²]

|            | Actual | Notional |
|------------|--------|----------|
| Heating    | 6.11   | 8.02     |
| Cooling    | 3.94   | 4.48     |
| Auxiliary  | 13.15  | 11.61    |
| Lighting   | 10.39  | 15.28    |
| Hot water  | 2.37   | 2.28     |
| Equipment* | 15.23  | 15.23    |
| TOTAL**    | 35.96  | 41.67    |

\* Energy used by equipment does not count towards the total for calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

### Energy Production by Technology [kWh/m²]

|                       | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems  | 0      | 0        |
| Wind turbines         | 0      | 0        |
| CHP generators        | 0      | 0        |
| Solar thermal systems | 0      | 0        |

### Energy & CO<sub>2</sub> Emissions Summary

|                                  | Actual | Notional |
|----------------------------------|--------|----------|
| Heating + cooling demand [MJ/m²] | 65.35  | 86.05    |
| Primary energy* [kWh/m²]         | 92.59  | 106.47   |
| Total emissions [kg/m²]          | 15.7   | 18.1     |

\* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

| System Type                                                                   | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEFF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|-------------------------------------------------------------------------------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| [ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                        | 17.8              | 47.5              | 6.1                | 3.9                | 13.2              | 0.81          | 3.36          | 0.95             | 4.5              |
| Notional                                                                      | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | ----             | ----             |
| [ST] No Heating or Cooling                                                    |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                        | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | 0                | 0                |
| Notional                                                                      | 24.9              | 61.1              | 8                  | 4.5                | 11.6              | 0.86          | 3.79          | ----             | ----             |

Key to terms

- Heat dem [MJ/m2]  
Cool dem [MJ/m2]  
Heat con [kWh/m2]  
Cool con [kWh/m2]  
Aux con [kWh/m2]  
Heat SSEFF  
Cool SSEER  
Heat gen SSEFF  
Cool gen SSEER  
ST  
HS  
HFT  
CFT
- = Heating energy demand  
= Cooling energy demand  
= Heating energy consumption  
= Cooling energy consumption  
= Auxiliary energy consumption  
= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)  
= Cooling system seasonal efficiency ratio  
= Heating generator seasonal efficiency  
= Cooling generator seasonal efficiency ratio  
= System type  
= Heat source  
= Heating fuel type  
= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

| Element                                                                  | U <sub>i</sub> -Typ                                                 | U <sub>i</sub> -Min | Surface where the minimum value occurs*  |
|--------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------|------------------------------------------|
| Wall                                                                     | 0.23                                                                | 0.18                | B100004F:Surf[1]                         |
| Floor                                                                    | 0.2                                                                 | -                   | UNKNOWN                                  |
| Roof                                                                     | 0.15                                                                | -                   | UNKNOWN                                  |
| Windows, roof windows, and rooflights                                    | 1.5                                                                 | 1.4                 | B100004F:Surf[0]                         |
| Personnel doors                                                          | 1.5                                                                 | -                   | No Personnel doors in building           |
| Vehicle access & similar large doors                                     | 1.5                                                                 | -                   | No Vehicle access doors in building      |
| High usage entrance doors                                                | 1.5                                                                 | -                   | No High usage entrance doors in building |
| U <sub>i</sub> -Typ = Typical individual element U-values [W/(m²K)]      | U <sub>i</sub> -Min = Minimum individual element U-values [W/(m²K)] |                     |                                          |
| * There might be more than one surface where the minimum U-value occurs. |                                                                     |                     |                                          |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3             |

Project name

TSW\_Non\_Resi Community Clean

As built

Date: Wed Oct 31 14:27:48 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.8

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.8

BRUKL compliance check version: v5.3.a.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO<sub>2</sub> emission rate for the building must not exceed the target

|                                                                                                    |                     |
|----------------------------------------------------------------------------------------------------|---------------------|
| CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum | 17.2                |
| Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum               | 17.2                |
| Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum             | 14.8                |
| Are emissions from the building less than or equal to the target?                                  | BER <= TER          |
| Are as built details the same as used in the BER calculations?                                     | Separate submission |

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

| Element                                                                                                                                                                                                                                                                                                                                                                                                                                      | U <sub>a</sub> -Limit | U <sub>a</sub> -Calc | U <sub>a</sub> -Calc | Surface where the maximum value occurs*  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------|----------------------|------------------------------------------|
| Wall**                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.35                  | 0.18                 | 0.18                 | B100004F:Surf[1]                         |
| Floor                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.25                  | -                    | -                    | UNKNOWN                                  |
| Roof                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.25                  | -                    | -                    | UNKNOWN                                  |
| Windows***, roof windows, and rooflights                                                                                                                                                                                                                                                                                                                                                                                                     | 2.2                   | 1.4                  | 1.4                  | B100004F:Surf[0]                         |
| Personnel doors                                                                                                                                                                                                                                                                                                                                                                                                                              | 2.2                   | -                    | -                    | No Personnel doors in building           |
| Vehicle access & similar large doors                                                                                                                                                                                                                                                                                                                                                                                                         | 1.5                   | -                    | -                    | No Vehicle access doors in building      |
| High usage entrance doors                                                                                                                                                                                                                                                                                                                                                                                                                    | 3.5                   | -                    | -                    | No High usage entrance doors in building |
| U <sub>a</sub> -Limit = Limiting area-weighted average U-values [W/(m <sup>2</sup> K)]<br>U <sub>a</sub> -Calc = Calculated area-weighted average U-values [W/(m <sup>2</sup> K)]<br>U <sub>a</sub> -Calc = Calculated maximum individual element U-values [W/(m <sup>2</sup> K)]                                                                                                                                                            |                       |                      |                      |                                          |
| * There might be more than one surface where the maximum U-value occurs.<br>** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.<br>*** Display windows and similar glazing are excluded from the U-value check.<br>N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool. |                       |                      |                      |                                          |

| Air Permeability                             | Worst acceptable standard | This building |
|----------------------------------------------|---------------------------|---------------|
| m <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa | 10                        | 3             |

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

|                                                                                              |       |
|----------------------------------------------------------------------------------------------|-------|
| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | YES   |
| Whole building electric power factor achieved by power factor correction                     | >0.95 |

1- TSW Clean

|                                                                                                      | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)]          | HR efficiency |
|------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|------------------------|---------------|
| <b>This system</b>                                                                                   | <b>1</b>           | <b>3.5</b>         | <b>0</b>           | <b>1.6</b>             | <b>0.7</b>    |
| <b>Standard value</b>                                                                                | <b>N/A</b>         | <b>2.55</b>        | <b>N/A</b>         | <b>1.6<sup>a</sup></b> | <b>0.5</b>    |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b> |                    |                    |                    |                        |               |
| <b>NO</b>                                                                                            |                    |                    |                    |                        |               |

<sup>a</sup> Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

| ID | System type in Non-domestic Building Services Compliance Guide                                          |
|----|---------------------------------------------------------------------------------------------------------|
| A  | Local supply or extract ventilation units serving a single area                                         |
| B  | Zonal supply system where the fan is remote from the zone                                               |
| C  | Zonal extract system where the fan is remote from the zone                                              |
| D  | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery |
| E  | Local supply and extract ventilation system serving a single area with heating and heat recovery        |
| F  | Other local ventilation units                                                                           |
| G  | Fan-assisted terminal VAV unit                                                                          |
| H  | Fan coil units                                                                                          |
| I  | Zonal extract system where the fan is remote from the zone with grease filter                           |

| Zone name            | ID of system type | SFP [W/(l/s)] |     |     |     |     |     |     |     |   |  | HR efficiency |          |
|----------------------|-------------------|---------------|-----|-----|-----|-----|-----|-----|-----|---|--|---------------|----------|
|                      |                   | A             | B   | C   | D   | E   | F   | G   | H   | I |  | Zone          | Standard |
| 01_A_Community_Space | Standard value    | 0.3           | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 |  |               |          |
| 01_A_Community_Space |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | - |  | -             | N/A      |
| 01_B_Gym_WCs         |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | - |  | -             | N/A      |
| 01_A_Creche_core     |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | - |  | -             | N/A      |
| 01_A_Creche_peri     |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | - |  | -             | N/A      |
| 01_B_Gym_core        |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | - |  | -             | N/A      |
| 01_B_Gym_peri        |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | - |  | -             | N/A      |

General lighting and display lighting

| Zone name            | Standard value | Luminous efficacy [lm/W] |      |              |  |  | General lighting [W] |  |
|----------------------|----------------|--------------------------|------|--------------|--|--|----------------------|--|
|                      |                | Luminaire                | Lamp | Display lamp |  |  |                      |  |
| 01_A_Community_Space |                | 60                       | 60   | 22           |  |  |                      |  |
| 01_B_Gym_WCs         |                | -                        | 90   | -            |  |  | 346                  |  |
| 01_A_Creche_core     |                | -                        | 90   | -            |  |  | 144                  |  |
| 01_A_Creche_peri     |                | 90                       | -    | -            |  |  | 858                  |  |
| 01_B_Gym_core        |                | 90                       | -    | -            |  |  | 679                  |  |
| 01_B_Gym_peri        |                | -                        | 90   | -            |  |  | 411                  |  |
| 01_B_Gym_peri        |                | -                        | 90   | -            |  |  | 595                  |  |

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone                 | Solar gain limit exceeded? (%) | Internal blinds used? |
|----------------------|--------------------------------|-----------------------|
| 01_A_Community_Space | NO (-75.5%)                    | NO                    |
| 01_B_Gym_WCs         | N/A                            | N/A                   |
| 01_A_Creche_core     | NO (-71.8%)                    | NO                    |
| 01_A_Creche_peri     | NO (-39.9%)                    | NO                    |
| 01_B_Gym_core        | NO (-82.2%)                    | NO                    |
| 01_B_Gym_peri        | NO (-56%)                      | NO                    |

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

|                                                                                        |    |
|----------------------------------------------------------------------------------------|----|
| Were alternative energy systems considered and analysed as part of the design process? | NO |
| Is evidence of such assessment available as a separate submission?                     | NO |
| Are any such measures included in the proposed design?                                 | NO |

## Technical Data Sheet (Actual vs. Notional Building)

### Building Global Parameters

### Building Use

|                             | Actual | Notional | % Area | Building Type                                             |
|-----------------------------|--------|----------|--------|-----------------------------------------------------------|
| Area [m²]                   | 519.2  | 519.2    |        | A1/A2 Retail/Financial and Professional services          |
| External area [m²]          | 353    | 353      |        | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways    |
| Weather                     | LON    | LON      |        | B1 Offices and Workshop businesses                        |
| Infiltration [m³/hm²@ 50Pa] | 3      | 3        |        | B2 to B7 General Industrial and Special Industrial Groups |
| Average conductance [W/K]   | 163.82 | 210.4    |        | B8 Storage or Distribution                                |
| Average U-value [W/m²K]     | 0.46   | 0.6      |        | C1 Hotels                                                 |
| Alpha value* [%]            | 10     | 10       |        | C2 Residential Institutions: Hospitals and Care Homes     |
|                             |        |          |        | C2 Residential Institutions: Residential schools          |
|                             |        |          |        | C2A Secure Residential Institutions                       |
|                             |        |          |        | Residential spaces                                        |

|     |                                                                    |
|-----|--------------------------------------------------------------------|
| 100 | D1 Non-residential Institutions: Community/Day Centre              |
|     | D1 Non-residential Institutions: Libraries, Museums, and Galleries |
|     | D1 Non-residential Institutions: Education                         |
|     | D1 Non-residential Institutions: Primary Health Care Building      |
|     | D2 General Assembly and Leisure, Night Clubs, and Theatres         |
|     | Others: Passenger terminals                                        |
|     | Others: Emergency services                                         |
|     | Others: Miscellaneous 24hr activities                              |
|     | Others: Car Parks 24 hrs                                           |
|     | Others: Stand alone utility block                                  |

### Energy Consumption by End Use [kWh/m²]

|            | Actual | Notional |
|------------|--------|----------|
| Heating    | 5.8    | 6.92     |
| Cooling    | 3.94   | 4.48     |
| Auxiliary  | 13.15  | 11.61    |
| Lighting   | 10.39  | 15.28    |
| Hot water  | 2.25   | 2.18     |
| Equipment* | 15.23  | 15.23    |
| TOTAL**    | 35.53  | 40.47    |

\* Energy used by equipment does not count towards the total for calculating emissions.  
\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

### Energy Production by Technology [kWh/m²]

|                       | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems  | 0      | 0        |
| Wind turbines         | 0      | 0        |
| CHP generators        | 0      | 0        |
| Solar thermal systems | 0      | 0        |

### Energy & CO<sub>2</sub> Emissions Summary

|                                  | Actual | Notional |
|----------------------------------|--------|----------|
| Heating + cooling demand [MJ/m²] | 65.35  | 86.05    |
| Primary energy* [kWh/m²]         | 91.91  | 101.64   |
| Total emissions [kg/m²]          | 14.8   | 17.2     |

\* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.



HVAC Systems Performance

| System Type                                                                             | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEFF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|-----------------------------------------------------------------------------------------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| [ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                  | 17.8              | 47.5              | 5.8                | 3.9                | 13.2              | 0.85          | 3.36          | 1                | 4.5              |
| Notional                                                                                | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | ----             | ----             |
| [ST] No Heating or Cooling                                                              |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                  | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | 0                | 0                |
| Notional                                                                                | 24.9              | 61.1              | 6.9                | 4.5                | 11.6              | 1             | 3.79          | ----             | ----             |

Key to terms

- Heat dem [MJ/m2]  
Cool dem [MJ/m2]  
Heat con [kWh/m2]  
Cool con [kWh/m2]  
Aux con [kWh/m2]  
Heat SSEFF  
Cool SSEER  
Heat gen SSEFF  
Cool gen SSEER  
ST  
HS  
HFT  
CFT
- = Heating energy demand  
= Cooling energy demand  
= Heating energy consumption  
= Cooling energy consumption  
= Auxiliary energy consumption  
= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)  
= Cooling system seasonal efficiency ratio  
= Heating generator seasonal efficiency  
= Cooling generator seasonal efficiency  
= System type  
= Heat source  
= Heating fuel type  
= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

| Element                                                                                                                                         | U <sub>i</sub> -Typ | U <sub>i</sub> -Min | Surface where the minimum value occurs*                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------------------------------------------------------|
| Wall                                                                                                                                            | 0.23                | 0.18                | B100004F:Surf[1]                                                    |
| Floor                                                                                                                                           | 0.2                 | -                   | UNKNOWN                                                             |
| Roof                                                                                                                                            | 0.15                | -                   | UNKNOWN                                                             |
| Windows, roof windows, and rooflights                                                                                                           | 1.5                 | 1.4                 | B100004F:Surf[0]                                                    |
| Personnel doors                                                                                                                                 | 1.5                 | -                   | No Personnel doors in building                                      |
| Vehicle access & similar large doors                                                                                                            | 1.5                 | -                   | No Vehicle access doors in building                                 |
| High usage entrance doors                                                                                                                       | 1.5                 | -                   | No High usage entrance doors in building                            |
| U <sub>i</sub> -Typ = Typical individual element U-values [W/(m²K)]<br>* There might be more than one surface where the minimum U-value occurs. |                     |                     | U <sub>i</sub> -Min = Minimum individual element U-values [W/(m²K)] |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3             |

Project name

TSW\_Non\_Resi

Industrial Lean

As built

Date: Wed Oct 31 12:39:28 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.8

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.8

BRUKL compliance check version: v5.3.a.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO<sub>2</sub> emission rate for the building must not exceed the target

|                                                                                                    |                     |
|----------------------------------------------------------------------------------------------------|---------------------|
| CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum | 26.2                |
| Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum               | 26.2                |
| Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum             | 18.8                |
| Are emissions from the building less than or equal to the target?                                  | BER <= TER          |
| Are as built details the same as used in the BER calculations?                                     | Separate submission |

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

| Element                                                                                                                                        | U <sub>g</sub> -Limit | U <sub>g</sub> -Calc | Surface where the maximum value occurs*                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------|----------------------------------------------------------------------------------------------|
| Wall**                                                                                                                                         | 0.35                  | 0.18                 | B1000009:Surf[0]                                                                             |
| Floor                                                                                                                                          | 0.25                  | 0.16                 | B1000009:Surf[1]                                                                             |
| Roof                                                                                                                                           | 0.25                  | 0.16                 | B1000017:Surf[2]                                                                             |
| Windows***, roof windows, and rooflights                                                                                                       | 2.2                   | 1.4                  | B100001C:Surf[0]                                                                             |
| Personnel doors                                                                                                                                | 2.2                   | -                    | No Personnel doors in building                                                               |
| Vehicle access & similar large doors                                                                                                           | 1.5                   | -                    | No Vehicle access doors in building                                                          |
| High usage entrance doors                                                                                                                      | 3.5                   | -                    | No High usage entrance doors in building                                                     |
| U <sub>g</sub> -Limit = Limiting area-weighted average U-values [W/(m <sup>2</sup> K)]                                                         |                       |                      | U <sub>g</sub> -Calc = Calculated maximum individual element U-values [W/(m <sup>2</sup> K)] |
| U <sub>g</sub> -Calc = Calculated area-weighted average U-values [W/(m <sup>2</sup> K)]                                                        |                       |                      |                                                                                              |
| * There might be more than one surface where the maximum U-value occurs.                                                                       |                       |                      |                                                                                              |
| ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.                 |                       |                      |                                                                                              |
| *** Display windows and similar glazing are excluded from the U-value check.                                                                   |                       |                      |                                                                                              |
| N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool. |                       |                      |                                                                                              |

| Air Permeability                             | Worst acceptable standard | This building |
|----------------------------------------------|---------------------------|---------------|
| m <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa | 10                        | 3             |

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

|                                                                                              |       |
|----------------------------------------------------------------------------------------------|-------|
| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | YES   |
| Whole building electric power factor achieved by power factor correction                     | >0.95 |

1- TSW Lean

|                                                                                                                                                                                                                                                   | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)]    | HR efficiency |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|------------------|---------------|
| This system                                                                                                                                                                                                                                       | 0.95               | 3.5                | 0                  | 1.6              | 0.7           |
| Standard value                                                                                                                                                                                                                                    | 0.91 <sup>*</sup>  | 2.55               | N/A                | 1.6 <sup>^</sup> | 0.5           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                                                                                         |                    |                    |                    |                  |               |
| * Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82. |                    |                    |                    |                  |               |
| <sup>^</sup> Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.                                                    |                    |                    |                    |                  |               |

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

| ID | System type in Non-domestic Building Services Compliance Guide                                          |
|----|---------------------------------------------------------------------------------------------------------|
| A  | Local supply or extract ventilation units serving a single area                                         |
| B  | Zonal supply system where the fan is remote from the zone                                               |
| C  | Zonal extract system where the fan is remote from the zone                                              |
| D  | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery |
| E  | Local supply and extract ventilation system serving a single area with heating and heat recovery        |
| F  | Other local ventilation units                                                                           |
| G  | Fan-assisted terminal VAV unit                                                                          |
| H  | Fan coil units                                                                                          |
| I  | Zonal extract system where the fan is remote from the zone with grease filter                           |

| Zone name                 | ID of system type | SFP [W/(l/s)] |     |     |     |     |     |     |     | HR efficiency |               |
|---------------------------|-------------------|---------------|-----|-----|-----|-----|-----|-----|-----|---------------|---------------|
|                           |                   | A             | B   | C   | D   | E   | F   | G   | H   | I             | Zone Standard |
| 0M_B_Mezzanine_Units      | Standard value    | 0.3           | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1             | -             |
| 0M_B_Mezzanine_Units      |                   | -             | -   | -   | -   | -   | -   | -   | -   | -             | N/A           |
| 0M_B_Store                |                   | -             | -   | -   | -   | -   | -   | -   | -   | -             | N/A           |
| 0M_A_Mezzanine_Units      |                   | -             | -   | -   | -   | -   | -   | -   | -   | -             | N/A           |
| 0M_B_Mezzanine_Units_core |                   | -             | -   | -   | -   | -   | -   | -   | -   | -             | N/A           |
| 0M_B_Mezzanine_Units_peri |                   | -             | -   | -   | -   | -   | -   | -   | -   | -             | N/A           |

General lighting and display lighting

| Zone name                   | Standard value | Luminous efficacy [lm/W] |      |              |  | General lighting [W] |
|-----------------------------|----------------|--------------------------|------|--------------|--|----------------------|
|                             |                | Luminaire                | Lamp | Display lamp |  |                      |
| 00_B_Industrial_Unit_2      | 90             | 60                       | 60   | 22           |  |                      |
| 0M_B_Storage_Void           | 90             | -                        | -    | -            |  | 6060                 |
| 0M_B_Industrial_Unit_2_Void | 90             | -                        | -    | -            |  | 87                   |
| 0M_B_Mezzanine_Units        | 90             | -                        | -    | -            |  | 0                    |
| 00_B_Industrial_Waste       | 90             | -                        | -    | -            |  | 1095                 |
| 0M_B_Store                  | 90             | -                        | -    | -            |  | 237                  |
| 00_A_Industrial_Unit_1      | 90             | -                        | -    | -            |  | 262                  |
|                             | 90             | -                        | -    | -            |  | 6195                 |

General lighting and display lighting

| General lighting and display lighting |           |      | Luminous efficacy [lm/W] |      | General lighting [W] |
|---------------------------------------|-----------|------|--------------------------|------|----------------------|
| Zone name                             | Luminaire | Lamp | Display lamp             |      |                      |
| Standard value                        |           |      | 60                       | 22   |                      |
| OM_A_Industrial_Unit_1_Void           | 90        | -    | -                        | 0    |                      |
| OM_A_Mezzanine_Units                  | 90        | -    | -                        | 2863 |                      |
| OM_B_Mezzanine_Units_core             | 90        | -    | -                        | 2054 |                      |
| OM_B_Mezzanine_Units_peri             | 90        | -    | -                        | 364  |                      |

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone                        | Solar gain limit exceeded? (%) | Internal blinds used? |
|-----------------------------|--------------------------------|-----------------------|
| 00_B_Industrial_Unit_2      | NO (-100%)                     | NO                    |
| 0M_B_Storage_Void           | N/A                            | N/A                   |
| 0M_B_Industrial_Unit_2_Void | NO (-99.9%)                    | NO                    |
| 0M_B_Mezzanine_Units        | YES (+30.7%)                   | NO                    |
| 00_B_Industrial_Waste       | N/A                            | N/A                   |
| 0M_B_Store                  | N/A                            | N/A                   |
| 00_A_Industrial_Unit_1      | N/A                            | N/A                   |
| 0M_A_Industrial_Unit_1_Void | N/A                            | N/A                   |
| 0M_A_Mezzanine_Units        | YES (+17%)                     | NO                    |
| 0M_B_Mezzanine_Units_core   | NO (-81.5%)                    | NO                    |
| 0M_B_Mezzanine_Units_peri   | YES (+4.2%)                    | NO                    |

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

|                                                                                        |    |
|----------------------------------------------------------------------------------------|----|
| Were alternative energy systems considered and analysed as part of the design process? | NO |
| Is evidence of such assessment available as a separate submission?                     | NO |
| Are any such measures included in the proposed design?                                 | NO |

Technical Data Sheet (Actual vs. Notional Building)

| Building Global Parameters  |         | Building Use |                                                                    |
|-----------------------------|---------|--------------|--------------------------------------------------------------------|
|                             |         | % Area       | Building Type                                                      |
| Area [m²]                   | Actual  | Notional     | A1/A2 Retail/Financial and Professional services                   |
| External area [m²]          | 3521.5  | 3521.5       | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways             |
| Weather                     | 5502.9  | 5502.9       | B1 Offices and Workshop businesses                                 |
| Infiltration [m³/hm²@ 50Pa] | Lon     | Lon          | B2 to B7 General Industrial and Special Industrial Groups          |
| Average conductance [W/K]   | 3       | 3            | B8 Storage or Distribution                                         |
| Average U-value [W/m²K]     | 1099.65 | 1569.35      | C1 Hotels                                                          |
| Alpha value* [%]            | 0.2     | 0.29         | C2 Residential Institutions: Hospitals and Care Homes              |
|                             | 10      | 10           | C2 Residential Institutions: Residential schools                   |
|                             |         |              | C2 Residential Institutions: Universities and colleges             |
|                             |         |              | C2A Secure Residential Institutions                                |
|                             |         |              | Residential spaces                                                 |
|                             |         |              | D1 Non-residential Institutions: Community/Day Centre              |
|                             |         |              | D1 Non-residential Institutions: Libraries, Museums, and Galleries |
|                             |         |              | D1 Non-residential Institutions: Education                         |
|                             |         |              | D1 Non-residential Institutions: Primary Health Care Building      |
|                             |         |              | D1 Non-residential Institutions: Crown and County Courts           |
|                             |         |              | D2 General Assembly and Leisure, Night Clubs, and Theatres         |
|                             |         |              | Others: Passenger terminals                                        |
|                             |         |              | Others: Emergency services                                         |
|                             |         |              | Others: Miscellaneous 24hr activities                              |
|                             |         |              | Others: Car Parks 24 hrs                                           |
|                             |         |              | Others: Stand alone utility block                                  |

Energy Consumption by End Use [kWh/m²]

|            | Actual | Notional |
|------------|--------|----------|
| Heating    | 2.14   | 3.88     |
| Cooling    | 3.26   | 3.8      |
| Auxiliary  | 6.45   | 5.2      |
| Lighting   | 24.66  | 37.79    |
| Hot water  | 4.6    | 4.78     |
| Equipment* | 36.18  | 36.03    |
| TOTAL**    | 41.11  | 55.46    |

\* Energy used by equipment does not count towards the total for calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

|                       | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems  | 0      | 0        |
| Wind turbines         | 0      | 0        |
| CHP generators        | 0      | 0        |
| Solar thermal systems | 0      | 0        |

Energy & CO<sub>2</sub> Emissions Summary

|                                  | Actual | Notional |
|----------------------------------|--------|----------|
| Heating + cooling demand [MJ/m²] | 45.6   | 63.88    |
| Primary energy* [kWh/m²]         | 111.1  | 150.63   |
| Total emissions [kg/m²]          | 18.8   | 26.2     |

\* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

| System Type                                                                   | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|-------------------------------------------------------------------------------|-------------------|-------------------|--------------------|--------------------|-------------------|--------------|---------------|------------------|------------------|
| [ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity |                   |                   |                    |                    |                   |              |               |                  |                  |
| Actual                                                                        | 22.9              | 144.5             | 7.8                | 12                 | 23.7              | 0.81         | 3.36          | 0.95             | 4.5              |
| Notional                                                                      | 0                 | 0                 | 0                  | 0                  | 0                 | 0            | 0             | ----             | ----             |
| [ST] No Heating or Cooling                                                    |                   |                   |                    |                    |                   |              |               |                  |                  |
| Actual                                                                        | 0                 | 0                 | 0                  | 0                  | 0                 | 0            | 0             | 0                | 0                |
| Notional                                                                      | 45.3              | 194.7             | 14.6               | 14.3               | 19.3              | 0.86         | 3.79          | ----             | ----             |

Key to terms

- Heat dem [MJ/m2]  
Cool dem [MJ/m2]  
Heat con [kWh/m2]  
Cool con [kWh/m2]  
Aux con [kWh/m2]  
Heat SSEFF  
Cool SSEER  
Heat gen SSEFF  
Cool gen SSEER  
ST  
HS  
HFT  
CFT
- = Heating energy demand  
= Cooling energy demand  
= Heating energy consumption  
= Cooling energy consumption  
= Auxiliary energy consumption  
= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)  
= Cooling system seasonal efficiency ratio  
= Heating generator seasonal efficiency  
= Cooling generator seasonal efficiency ratio  
= System type  
= Heat source  
= Heating fuel type  
= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

| Element                                                                                                                                         | U <sub>i</sub> -Typ | U <sub>i</sub> -Min | Surface where the minimum value occurs*                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------------------------------------------------------|
| Wall                                                                                                                                            | 0.23                | 0.18                | B1000009:Surf[0]                                                    |
| Floor                                                                                                                                           | 0.2                 | 0.16                | B1000009:Surf[1]                                                    |
| Roof                                                                                                                                            | 0.15                | 0.16                | B1000017:Surf[2]                                                    |
| Windows, roof windows, and rooflights                                                                                                           | 1.5                 | 1.4                 | B100001C:Surf[0]                                                    |
| Personnel doors                                                                                                                                 | 1.5                 | -                   | No Personnel doors in building                                      |
| Vehicle access & similar large doors                                                                                                            | 1.5                 | -                   | No Vehicle access doors in building                                 |
| High usage entrance doors                                                                                                                       | 1.5                 | -                   | No High usage entrance doors in building                            |
| U <sub>i</sub> -Typ = Typical individual element U-values [W/(m²K)]<br>* There might be more than one surface where the minimum U-value occurs. |                     |                     | U <sub>i</sub> -Min = Minimum individual element U-values [W/(m²K)] |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3             |

Project name

TSW\_Non\_Resi

Industrial Clean

As built

Date: Wed Oct 31 14:25:29 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.8

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.8

BRUKL compliance check version: v5.3.a.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO<sub>2</sub> emission rate for the building must not exceed the target

|                                                                                                    |                     |
|----------------------------------------------------------------------------------------------------|---------------------|
| CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum | 25.5                |
| Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum               | 25.5                |
| Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum             | 18.5                |
| Are emissions from the building less than or equal to the target?                                  | BER <= TER          |
| Are as built details the same as used in the BER calculations?                                     | Separate submission |

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

| Element                                                                                                                                        | U <sub>a</sub> -Limit | U <sub>a</sub> -Calc | U <sub>a</sub> -Calc | Surface where the maximum value occurs*  |
|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------|----------------------|------------------------------------------|
| Wall**                                                                                                                                         | 0.35                  | 0.18                 | 0.18                 | B1000009:Surf[0]                         |
| Floor                                                                                                                                          | 0.25                  | 0.16                 | 0.16                 | B1000009:Surf[1]                         |
| Roof                                                                                                                                           | 0.25                  | 0.16                 | 0.16                 | B1000017:Surf[2]                         |
| Windows***, roof windows, and rooflights                                                                                                       | 2.2                   | 1.4                  | 1.4                  | B100001C:Surf[0]                         |
| Personnel doors                                                                                                                                | 2.2                   | -                    | -                    | No Personnel doors in building           |
| Vehicle access & similar large doors                                                                                                           | 1.5                   | -                    | -                    | No Vehicle access doors in building      |
| High usage entrance doors                                                                                                                      | 3.5                   | -                    | -                    | No High usage entrance doors in building |
| U <sub>a</sub> -Limit = Limiting area-weighted average U-values [W/(m <sup>2</sup> K)]                                                         |                       |                      |                      |                                          |
| U <sub>a</sub> -Calc = Calculated area-weighted average U-values [W/(m <sup>2</sup> K)]                                                        |                       |                      |                      |                                          |
| U <sub>a</sub> -Calc = Calculated maximum individual element U-values [W/(m <sup>2</sup> K)]                                                   |                       |                      |                      |                                          |
| * There might be more than one surface where the maximum U-value occurs.                                                                       |                       |                      |                      |                                          |
| ** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.                 |                       |                      |                      |                                          |
| *** Display windows and similar glazing are excluded from the U-value check.                                                                   |                       |                      |                      |                                          |
| N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool. |                       |                      |                      |                                          |

| Air Permeability                             | Worst acceptable standard | This building |
|----------------------------------------------|---------------------------|---------------|
| m <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa | 10                        | 3             |

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

|                                                                                              |       |
|----------------------------------------------------------------------------------------------|-------|
| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | YES   |
| Whole building electric power factor achieved by power factor correction                     | >0.95 |

1- TSW Clean

|                                                                                                      | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)]          | HR efficiency |
|------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|------------------------|---------------|
| <b>This system</b>                                                                                   | <b>1</b>           | <b>3.5</b>         | <b>0</b>           | <b>1.6</b>             | <b>0.7</b>    |
| <b>Standard value</b>                                                                                | <b>N/A</b>         | <b>2.55</b>        | <b>N/A</b>         | <b>1.6<sup>^</sup></b> | <b>0.5</b>    |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b> |                    |                    |                    |                        |               |
| <b>NO</b>                                                                                            |                    |                    |                    |                        |               |

<sup>^</sup> Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

| ID | System type in Non-domestic Building Services Compliance Guide                                          |
|----|---------------------------------------------------------------------------------------------------------|
| A  | Local supply or extract ventilation units serving a single area                                         |
| B  | Zonal supply system where the fan is remote from the zone                                               |
| C  | Zonal extract system where the fan is remote from the zone                                              |
| D  | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery |
| E  | Local supply and extract ventilation system serving a single area with heating and heat recovery        |
| F  | Other local ventilation units                                                                           |
| G  | Fan-assisted terminal VAV unit                                                                          |
| H  | Fan coil units                                                                                          |
| I  | Zonal extract system where the fan is remote from the zone with grease filter                           |

| Zone name                 | ID of system type | SFP [W/(l/s)] |     |     |     |     |     |     |     | HR efficiency |               |
|---------------------------|-------------------|---------------|-----|-----|-----|-----|-----|-----|-----|---------------|---------------|
|                           |                   | A             | B   | C   | D   | E   | F   | G   | H   | I             | Zone Standard |
| 0M_B_Mezzanine_Units      | Standard value    | 0.3           | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1             | -             |
| 0M_B_Mezzanine_Units      |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | -             | N/A           |
| 0M_B_Store                |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | -             | N/A           |
| 0M_A_Mezzanine_Units      |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | -             | N/A           |
| 0M_B_Mezzanine_Units_core |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | -             | N/A           |
| 0M_B_Mezzanine_Units_peri |                   | -             | -   | -   | -   | -   | -   | -   | 0.3 | -             | N/A           |

General lighting and display lighting

| General lighting and display lighting |                | Luminous efficacy [lm/W] |      |              | General lighting [W] |
|---------------------------------------|----------------|--------------------------|------|--------------|----------------------|
| Zone name                             | Standard value | Luminaire                | Lamp | Display lamp |                      |
| 00_B_Industrial_Unit_2                |                | 60                       | 60   | 22           |                      |
| 0M_B_Storage_Void                     |                | 90                       | -    | -            | 6060                 |
| 0M_B_Industrial_Unit_2_Void           |                | 90                       | -    | -            | 87                   |
| 0M_B_Mezzanine_Units                  |                | 90                       | -    | -            | 0                    |
| 00_B_Industrial_Waste                 |                | 90                       | -    | -            | 1095                 |
| 0M_B_Store                            |                | 90                       | -    | -            | 237                  |
| 00_A_Industrial_Unit_1                |                | 90                       | -    | -            | 262                  |
| 0M_A_Industrial_Unit_1_Void           |                | 90                       | -    | -            | 6195                 |
| 0M_A_Mezzanine_Units                  |                | 90                       | -    | -            | 0                    |
|                                       |                | 90                       | -    | -            | 2863                 |

| General lighting and display lighting |                          |      |              |
|---------------------------------------|--------------------------|------|--------------|
| Zone name                             | Luminous efficacy [lm/W] |      |              |
|                                       | Luminaire                | Lamp | Display lamp |
| Standard value                        |                          |      |              |
| 0M_B_Mezzanine_Units_core             | 60                       | 60   | 22           |
| 0M_B_Mezzanine_Units_peri             | 90                       | -    | -            |
| 0M_B_Mezzanine_Units_peri             | 90                       | -    | -            |
|                                       |                          |      | 2054         |
|                                       |                          |      | 364          |

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone                        | Solar gain limit exceeded? (%) | Internal blinds used? |
|-----------------------------|--------------------------------|-----------------------|
| 00_B_Industrial_Unit_2      | NO (-100%)                     | NO                    |
| 0M_B_Storage_Void           | N/A                            | N/A                   |
| 0M_B_Industrial_Unit_2_Void | NO (-99.9%)                    | NO                    |
| 0M_B_Mezzanine_Units        | YES (+30.7%)                   | NO                    |
| 00_B_Industrial_Waste       | N/A                            | N/A                   |
| 0M_B_Store                  | N/A                            | N/A                   |
| 00_A_Industrial_Unit_1      | N/A                            | N/A                   |
| 0M_A_Industrial_Unit_1_Void | N/A                            | N/A                   |
| 0M_A_Mezzanine_Units        | YES (+17%)                     | NO                    |
| 0M_B_Mezzanine_Units_core   | NO (-81.5%)                    | NO                    |
| 0M_B_Mezzanine_Units_peri   | YES (+4.2%)                    | NO                    |

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

|                                                                                        |    |
|----------------------------------------------------------------------------------------|----|
| Were alternative energy systems considered and analysed as part of the design process? | NO |
| Is evidence of such assessment available as a separate submission?                     | NO |
| Are any such measures included in the proposed design?                                 | NO |

# Technical Data Sheet (Actual vs. Notional Building)

| Building Global Parameters                                                                        |         |        | Building Use |                                                           |
|---------------------------------------------------------------------------------------------------|---------|--------|--------------|-----------------------------------------------------------|
|                                                                                                   |         | Actual | Notional     | % Area Building Type                                      |
| Area [m²]                                                                                         |         | 3521.5 | 3521.5       | A1/A2 Retail/Financial and Professional services          |
| External area [m²]                                                                                |         | 5502.9 | 5502.9       | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways    |
| Weather                                                                                           |         | LOn    | LOn          | B1 Offices and Workshop businesses                        |
| Infiltration [m³/hm²@ 50Pa]                                                                       | 3       |        | 3            | B2 to B7 General Industrial and Special Industrial Groups |
| Average conductance [W/K]                                                                         | 1099.65 |        | 1569.35      | B8 Storage or Distribution                                |
| Average U-value [W/m²K]                                                                           | 0.2     |        | 0.29         | C1 Hotels                                                 |
| Alpha value* [%]                                                                                  | 10      |        | 10           | C2 Residential Institutions: Hospitals and Care Homes     |
| * Percentage of the building's average heat transfer coefficient which is due to thermal bridging |         |        |              |                                                           |
| Residential spaces                                                                                |         |        |              |                                                           |
| D1 Non-residential Institutions: Community/Day Centre                                             |         |        |              |                                                           |
| D1 Non-residential Institutions: Libraries, Museums, and Galleries                                |         |        |              |                                                           |
| D1 Non-residential Institutions: Education                                                        |         |        |              |                                                           |
| D1 Non-residential Institutions: Primary Health Care Building                                     |         |        |              |                                                           |
| D2 General Assembly and Leisure, Night Clubs, and Theatres                                        |         |        |              |                                                           |
| Others: Passenger terminals                                                                       |         |        |              |                                                           |
| Others: Emergency services                                                                        |         |        |              |                                                           |
| Others: Miscellaneous 24hr activities                                                             |         |        |              |                                                           |
| Others: Car Parks 24 hrs                                                                          |         |        |              |                                                           |
| Others: Stand alone utility block                                                                 |         |        |              |                                                           |

## Energy Consumption by End Use [kWh/m²]

|            | Actual | Notional |
|------------|--------|----------|
| Heating    | 2      | 3.35     |
| Cooling    | 3.4    | 3.8      |
| Auxiliary  | 6.45   | 5.2      |
| Lighting   | 25.24  | 37.79    |
| Hot water  | 4.37   | 4.58     |
| Equipment* | 36.18  | 36.03    |
| TOTAL**    | 41.47  | 54.72    |

\* Energy used by equipment does not count towards the total for calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

## Energy Production by Technology [kWh/m²]

|                       | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems  | 0      | 0        |
| Wind turbines         | 0      | 0        |
| CHP generators        | 0      | 0        |
| Solar thermal systems | 0      | 0        |

## Energy & CO₂ Emissions Summary

|                                  | Actual | Notional |
|----------------------------------|--------|----------|
| Heating + cooling demand [MJ/m²] | 47.23  | 63.88    |
| Primary energy* [kWh/m²]         | 112.69 | 146.8    |
| Total emissions [kg/m²]          | 18.5   | 25.5     |

\* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

| System Type                                                                             | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEFF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|-----------------------------------------------------------------------------------------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| [ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                  | 22.5              | 150.8             | 7.3                | 12.5               | 23.7              | 0.85          | 3.36          | 1                | 4.5              |
| Notional                                                                                | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | ----             | ----             |
| [ST] No Heating or Cooling                                                              |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                  | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | 0                | 0                |
| Notional                                                                                | 45.3              | 194.7             | 12.6               | 14.3               | 19.3              | 1             | 3.79          | ----             | ----             |

Key to terms

- Heat dem [MJ/m2]  
Cool dem [MJ/m2]  
Heat con [kWh/m2]  
Cool con [kWh/m2]  
Aux con [kWh/m2]  
Heat SSEFF  
Cool SSEER  
Heat gen SSEFF  
Cool gen SSEER  
ST  
HS  
HFT  
CFT
- = Heating energy demand  
= Cooling energy demand  
= Heating energy consumption  
= Cooling energy consumption  
= Auxiliary energy consumption  
= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)  
= Cooling system seasonal energy efficiency ratio  
= Heating generator seasonal efficiency  
= Cooling generator seasonal efficiency ratio  
= System type  
= Heat source  
= Heating fuel type  
= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

| Element                                                                                                                                         | U <sub>i</sub> -Typ | U <sub>i</sub> -Min | Surface where the minimum value occurs*                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------------------------------------------------------|
| Wall                                                                                                                                            | 0.23                | 0.18                | B1000009:Surf[0]                                                    |
| Floor                                                                                                                                           | 0.2                 | 0.16                | B1000009:Surf[1]                                                    |
| Roof                                                                                                                                            | 0.15                | 0.16                | B1000017:Surf[2]                                                    |
| Windows, roof windows, and rooflights                                                                                                           | 1.5                 | 1.4                 | B100001C:Surf[0]                                                    |
| Personnel doors                                                                                                                                 | 1.5                 | -                   | No Personnel doors in building                                      |
| Vehicle access & similar large doors                                                                                                            | 1.5                 | -                   | No Vehicle access doors in building                                 |
| High usage entrance doors                                                                                                                       | 1.5                 | -                   | No High usage entrance doors in building                            |
| U <sub>i</sub> -Typ = Typical individual element U-values [W/(m²K)]<br>* There might be more than one surface where the minimum U-value occurs. |                     |                     | U <sub>i</sub> -Min = Minimum individual element U-values [W/(m²K)] |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3             |



BRUKL Output Document

Compliance with England Building Regulations Part L 2013

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

|                                                                                              |       |
|----------------------------------------------------------------------------------------------|-------|
| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | YES   |
| Whole building electric power factor achieved by power factor correction                     | >0.95 |

| 1- TSW Lean                                                                                                                                                                                                                                       |                    |                    |                    |               |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
|                                                                                                                                                                                                                                                   | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
| This system                                                                                                                                                                                                                                       | 0.95               | 3.5                | 0                  | 1.6           | 0.7           |
| Standard value                                                                                                                                                                                                                                    | 0.91*              | 2.55               | N/A                | 1.6^          | 0.5           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system NO                                                                                                                                                      |                    |                    |                    |               |               |
| * Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82. |                    |                    |                    |               |               |
| ^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.                                                               |                    |                    |                    |               |               |

"No HWS in project, or hot water is provided by HVAC system"

| Local mechanical ventilation, exhaust, and terminal units |                                                                                                         |  |  |  |  |  |  |  |  |
|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|
| ID                                                        | System type in Non-domestic Building Services Compliance Guide                                          |  |  |  |  |  |  |  |  |
| A                                                         | Local supply or extract ventilation units serving a single area                                         |  |  |  |  |  |  |  |  |
| B                                                         | Zonal supply system where the fan is remote from the zone                                               |  |  |  |  |  |  |  |  |
| C                                                         | Zonal extract system where the fan is remote from the zone                                              |  |  |  |  |  |  |  |  |
| D                                                         | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery |  |  |  |  |  |  |  |  |
| E                                                         | Local supply and extract ventilation system serving a single area with heating and heat recovery        |  |  |  |  |  |  |  |  |
| F                                                         | Other local ventilation units                                                                           |  |  |  |  |  |  |  |  |
| G                                                         | Fan-assisted terminal VAV unit                                                                          |  |  |  |  |  |  |  |  |
| H                                                         | Fan coil units                                                                                          |  |  |  |  |  |  |  |  |
| I                                                         | Zonal extract system where the fan is remote from the zone with grease filter                           |  |  |  |  |  |  |  |  |

| Zone name     | ID of system type | SFP [W/(l/s)]  |     |     |     |     |     |     |     |     | HR efficiency |      |
|---------------|-------------------|----------------|-----|-----|-----|-----|-----|-----|-----|-----|---------------|------|
|               |                   | A              | B   | C   | D   | E   | F   | G   | H   | I   |               |      |
|               |                   | Standard value | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1             | Zone |
| 0M_A_Retail_1 |                   | -              | -   | -   | -   | -   | -   | -   | -   | 0.3 | -             | N/A  |
| 0M_A_Retail_2 |                   |                | -   | -   | -   | -   | -   | -   | -   | 0.3 | -             | N/A  |

| General lighting and display lighting |  |                |  | Luminous efficacy [lm/W] |      |              |                      |
|---------------------------------------|--|----------------|--|--------------------------|------|--------------|----------------------|
| Zone name                             |  | Standard value |  | Luminaire                | Lamp | Display lamp | General lighting [W] |
| 0M_A_Retail_1                         |  |                |  | 60                       | 60   | 22           |                      |
| 0M_A_Retail_2                         |  |                |  | -                        | 85   | 60           | 884                  |
|                                       |  |                |  | -                        | 85   | 60           | 894                  |

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone          | Solar gain limit exceeded? (%) | Internal blinds used? |
|---------------|--------------------------------|-----------------------|
| 0M_A_Retail_1 | NO (-4.3%)                     | NO                    |
| 0M_A_Retail_2 | YES (+0.7%)                    | NO                    |

|                                |             |
|--------------------------------|-------------|
| Project name                   | As built    |
| TSW_Non_Resi                   | Retail Lean |
| Date: Wed Oct 31 11:17:17 2018 |             |

| Administrative information                               |  |
|----------------------------------------------------------|--|
| Building Details                                         |  |
| Address: Address 1, City, Postcode                       |  |
| Owner Details                                            |  |
| Name: Name                                               |  |
| Telephone number: Phone                                  |  |
| Address: Street Address, City, Postcode                  |  |
| Certifier details                                        |  |
| Name: Name                                               |  |
| Telephone number: Phone                                  |  |
| Address: Street Address, City, Postcode                  |  |
| Building Details                                         |  |
| Calculation engine: Apache                               |  |
| Calculation engine version: 7.0.8                        |  |
| Interface to calculation engine: IES Virtual Environment |  |
| Interface to calculation engine version: 7.0.8           |  |
| BRUKL compliance check version: v5.3.a.0                 |  |

Criterion 1: The calculated CO2 emission rate for the building must not exceed the target

|                                                                   |                     |
|-------------------------------------------------------------------|---------------------|
| CO2 emission rate from the notional building, kgCO2/m².annum      | 46.4                |
| Target CO2 emission rate (TER), kgCO2/m².annum                    | 46.4                |
| Building CO2 emission rate (BER), kgCO2/m².annum                  | 35.6                |
| Are emissions from the building less than or equal to the target? | BER <= TER          |
| Are as built details the same as used in the BER calculations?    | Separate submission |

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

| Element                                                                                                                                                                                                                                                                                                                                                                                                                                      | Ua-Limit | Ua-Calc | Ua-Calc | Surface where the maximum value occurs*  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------|---------|------------------------------------------|
| Wall**                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.35     | 0.18    | 0.18    | B1000042:Surf[4]                         |
| Floor                                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.25     | -       | -       | UNKNOWN                                  |
| Roof                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.25     | -       | -       | UNKNOWN                                  |
| Windows***, roof windows, and rooflights                                                                                                                                                                                                                                                                                                                                                                                                     | 2.2      | 1.4     | 1.4     | B1000042:Surf[0]                         |
| Personnel doors                                                                                                                                                                                                                                                                                                                                                                                                                              | 2.2      | -       | -       | No Personnel doors in building           |
| Vehicle access & similar large doors                                                                                                                                                                                                                                                                                                                                                                                                         | 1.5      | -       | -       | No Vehicle access doors in building      |
| High usage entrance doors                                                                                                                                                                                                                                                                                                                                                                                                                    | 3.5      | -       | -       | No High usage entrance doors in building |
| Ua-Limit = Limiting area-weighted average U-values [W/(m²K)]<br>Ua-Calc = Calculated area-weighted average U-values [W/(m²K)]<br>U-Calc = Calculated maximum individual element U-values [W/(m²K)]                                                                                                                                                                                                                                           |          |         |         |                                          |
| * There might be more than one surface where the maximum U-value occurs.<br>** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.<br>*** Display windows and similar glazing are excluded from the U-value check.<br>N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool. |          |         |         |                                          |

| Air Permeability   | Worst acceptable standard | This building |
|--------------------|---------------------------|---------------|
| m³/(h.m²) at 50 Pa | 10                        | 3             |



HVAC Systems Performance

| System Type                                                                   | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|-------------------------------------------------------------------------------|-------------------|-------------------|--------------------|--------------------|-------------------|--------------|---------------|------------------|------------------|
| [ST] Fan coil systems, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity |                   |                   |                    |                    |                   |              |               |                  |                  |
| Actual                                                                        | 27.6              | 159.4             | 9.4                | 13.2               | 21.9              | 0.81         | 3.36          | 0.95             | 4.5              |
| Notional                                                                      | 0                 | 0                 | 0                  | 0                  | 0                 | 0            | 0             | ----             | ----             |
| [ST] No Heating or Cooling                                                    |                   |                   |                    |                    |                   |              |               |                  |                  |
| Actual                                                                        | 0                 | 0                 | 0                  | 0                  | 0                 | 0            | 0             | 0                | 0                |
| Notional                                                                      | 28.4              | 165               | 9.1                | 12.1               | 19                | 0.86         | 3.79          | ----             | ----             |

Key to terms

- Heat dem [MJ/m2]  
Cool dem [MJ/m2]  
Heat con [kWh/m2]  
Cool con [kWh/m2]  
Aux con [kWh/m2]  
Heat SSEFF  
Cool SSEER  
Heat gen SSEFF  
Cool gen SSEER  
ST  
HS  
HFT  
CFT
- = Heating energy demand  
= Cooling energy demand  
= Heating energy consumption  
= Cooling energy consumption  
= Auxiliary energy consumption  
= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)  
= Cooling system seasonal efficiency ratio  
= Heating generator seasonal efficiency  
= Cooling generator seasonal efficiency ratio  
= System type  
= Heat source  
= Heating fuel type  
= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

| Element                                                                                                                                         | U <sub>i</sub> -Typ | U <sub>i</sub> -Min | Surface where the minimum value occurs*                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------------------------------------------------------|
| Wall                                                                                                                                            | 0.23                | 0.18                | B1000042:Surf[4]                                                    |
| Floor                                                                                                                                           | 0.2                 | -                   | UNKNOWN                                                             |
| Roof                                                                                                                                            | 0.15                | -                   | UNKNOWN                                                             |
| Windows, roof windows, and rooflights                                                                                                           | 1.5                 | 1.4                 | B1000042:Surf[0]                                                    |
| Personnel doors                                                                                                                                 | 1.5                 | -                   | No Personnel doors in building                                      |
| Vehicle access & similar large doors                                                                                                            | 1.5                 | -                   | No Vehicle access doors in building                                 |
| High usage entrance doors                                                                                                                       | 1.5                 | -                   | No High usage entrance doors in building                            |
| U <sub>i</sub> -Typ = Typical individual element U-values [W/(m²K)]<br>* There might be more than one surface where the minimum U-value occurs. |                     |                     | U <sub>i</sub> -Min = Minimum individual element U-values [W/(m²K)] |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3             |

Project name

TSW\_Non\_Resi

Retail Clean

As built

Date: Wed Oct 31 14:23:54 2018

Administrative information

Building Details

Address: Address 1, City, Postcode

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.8

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.8

BRUKL compliance check version: v5.3.a.0

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Criterion 1: The calculated CO<sub>2</sub> emission rate for the building must not exceed the target

|                                                                                                    |                     |
|----------------------------------------------------------------------------------------------------|---------------------|
| CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum | 45.5                |
| Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum               | 45.5                |
| Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum             | 34.3                |
| Are emissions from the building less than or equal to the target?                                  | BER <= TER          |
| Are as built details the same as used in the BER calculations?                                     | Separate submission |

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

| Element                                  | U <sub>a</sub> -Limit | U <sub>a</sub> -Calc | U <sub>a</sub> -Calc | Surface where the maximum value occurs*  |
|------------------------------------------|-----------------------|----------------------|----------------------|------------------------------------------|
| Wall**                                   | 0.35                  | 0.18                 | 0.18                 | B1000042:Surf[4]                         |
| Floor                                    | 0.25                  | -                    | -                    | UNKNOWN                                  |
| Roof                                     | 0.25                  | -                    | -                    | UNKNOWN                                  |
| Windows***, roof windows, and rooflights | 2.2                   | 1.4                  | 1.4                  | B1000042:Surf[0]                         |
| Personnel doors                          | 2.2                   | -                    | -                    | No Personnel doors in building           |
| Vehicle access & similar large doors     | 1.5                   | -                    | -                    | No Vehicle access doors in building      |
| High usage entrance doors                | 3.5                   | -                    | -                    | No High usage entrance doors in building |

U<sub>a</sub>-Limit = Limiting area-weighted average U-values [W/(m<sup>2</sup>K)]  
U<sub>a</sub>-Calc = Calculated area-weighted average U-values [W/(m<sup>2</sup>K)]  
U<sub>a</sub>-Calc = Calculated maximum individual element U-values [W/(m<sup>2</sup>K)]  
\* There might be more than one surface where the maximum U-value occurs.  
\*\* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.  
\*\*\* Display windows and similar glazing are excluded from the U-value check.  
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

| Air Permeability                             | Worst acceptable standard | This building |
|----------------------------------------------|---------------------------|---------------|
| m <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa | 10                        | 3             |

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

|                                                                                              |       |
|----------------------------------------------------------------------------------------------|-------|
| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | YES   |
| Whole building electric power factor achieved by power factor correction                     | >0.95 |

1- TSW Clean

|                                                                                           | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                               | 1                  | 3.5                | 0                  | 1.6           | 0.7           |
| Standard value                                                                            | N/A                | 2.55               | N/A                | 1.6^          | 0.5           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system | NO                 |                    |                    |               |               |

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

| ID | System type in Non-domestic Building Services Compliance Guide                                          |
|----|---------------------------------------------------------------------------------------------------------|
| A  | Local supply or extract ventilation units serving a single area                                         |
| B  | Zonal supply system where the fan is remote from the zone                                               |
| C  | Zonal extract system where the fan is remote from the zone                                              |
| D  | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery |
| E  | Local supply and extract ventilation system serving a single area with heating and heat recovery        |
| F  | Other local ventilation units                                                                           |
| G  | Fan-assisted terminal VAV unit                                                                          |
| H  | Fan coil units                                                                                          |
| I  | Zonal extract system where the fan is remote from the zone with grease filter                           |

| Zone name     | ID of system type | A   | B   | C   | D   | E   | F   | G   | H   | I | HR efficiency |
|---------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|---|---------------|
|               | Standard value    | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | Zone Standard |
| 0M_A_Retail_1 |                   | -   | -   | -   | -   | -   | -   | -   | 0.3 | - | N/A           |
| 0M_A_Retail_2 |                   | -   | -   | -   | -   | -   | -   | -   | 0.3 | - | N/A           |

General lighting and display lighting

| Zone name     | Luminous efficacy [lm/W] |      |              |              |                      | General lighting [W] |  |
|---------------|--------------------------|------|--------------|--------------|----------------------|----------------------|--|
|               | Luminaire                | Lamp | Display lamp | Display lamp | General lighting [W] |                      |  |
|               | Standard value           | 60   | 60           | 22           |                      |                      |  |
| 0M_A_Retail_1 | -                        | 85   | 60           | 60           | 884                  |                      |  |
| 0M_A_Retail_2 | -                        | 85   | 60           | 60           | 894                  |                      |  |

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone          | Solar gain limit exceeded? (%) | Internal blinds used? |
|---------------|--------------------------------|-----------------------|
| 0M_A_Retail_1 | NO (-4.3%)                     | NO                    |
| 0M_A_Retail_2 | YES (+0.7%)                    | NO                    |

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

|                                                                                        |    |
|----------------------------------------------------------------------------------------|----|
| Were alternative energy systems considered and analysed as part of the design process? | NO |
| Is evidence of such assessment available as a separate submission?                     | NO |
| Are any such measures included in the proposed design?                                 | NO |

Technical Data Sheet (Actual vs. Notional Building)

| Building Global Parameters |        |          | Building Use |               |
|----------------------------|--------|----------|--------------|---------------|
|                            | Actual | Notional | % Area       | Building Type |

| Area [m²]                                                                                         | 150.5  | 150.5 | 100 | A1/A2 Retail/Financial and Professional services          |
|---------------------------------------------------------------------------------------------------|--------|-------|-----|-----------------------------------------------------------|
| External area [m²]                                                                                | 127.2  | 127.2 |     | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways    |
| Weather                                                                                           | LON    | LON   |     | B1 Offices and Workshop businesses                        |
| Infiltration [m³/hm²@ 50Pa]                                                                       | 3      | 3     |     | B2 to B7 General Industrial and Special Industrial Groups |
| Average conductance [W/K]                                                                         | 101.16 | 53.22 |     | B8 Storage or Distribution                                |
| Average U-value [W/m²K]                                                                           | 0.8    | 0.42  |     | C1 Hotels                                                 |
| Alpha value* [%]                                                                                  | 9.41   | 10    |     | C2 Residential Institutions: Hospitals and Care Homes     |
| * Percentage of the building's average heat transfer coefficient which is due to thermal bridging |        |       |     |                                                           |
| C2 Residential Institutions: Residential schools                                                  |        |       |     |                                                           |
| C2A Secure Residential Institutions: Universities and colleges                                    |        |       |     |                                                           |
| Residential spaces                                                                                |        |       |     |                                                           |
| D1 Non-residential Institutions: Community/Day Centre                                             |        |       |     |                                                           |
| D1 Non-residential Institutions: Libraries, Museums, and Galleries                                |        |       |     |                                                           |
| D1 Non-residential Institutions: Education                                                        |        |       |     |                                                           |
| D1 Non-residential Institutions: Primary Health Care Building                                     |        |       |     |                                                           |
| D1 Non-residential Institutions: Crown and County Courts                                          |        |       |     |                                                           |
| D2 General Assembly and Leisure, Night Clubs, and Theatres                                        |        |       |     |                                                           |
| Others: Passenger terminals                                                                       |        |       |     |                                                           |
| Others: Emergency services                                                                        |        |       |     |                                                           |
| Others: Miscellaneous 24hr activities                                                             |        |       |     |                                                           |
| Others: Car Parks 24 hrs                                                                          |        |       |     |                                                           |
| Others: Stand alone utility block                                                                 |        |       |     |                                                           |

Energy Consumption by End Use [kWh/m²]

|            | Actual | Notional |
|------------|--------|----------|
| Heating    | 8.97   | 7.88     |
| Cooling    | 13.19  | 12.09    |
| Auxiliary  | 21.92  | 18.98    |
| Lighting   | 30.25  | 55.89    |
| Hot water  | 1.95   | 1.79     |
| Equipment* | 20.26  | 20.26    |
| TOTAL**    | 76.28  | 96.63    |

\* Energy used by equipment does not count towards the total for calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

|                       | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems  | 0      | 0        |
| Wind turbines         | 0      | 0        |
| CHP generators        | 0      | 0        |
| Solar thermal systems | 0      | 0        |

Energy & CO<sub>2</sub> Emissions Summary

|                                  | Actual | Notional |
|----------------------------------|--------|----------|
| Heating + cooling demand [MJ/m²] | 186.92 | 193.35   |
| Primary energy* [kWh/m²]         | 208.77 | 268.5    |
| Total emissions [kg/m²]          | 34.3   | 45.5     |

\* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

| System Type                                                                             | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEFF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|-----------------------------------------------------------------------------------------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| [ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                  | 27.6              | 159.4             | 9                  | 13.2               | 21.9              | 0.85          | 3.36          | 1                | 4.5              |
| Notional                                                                                | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | ----             | ----             |
| [ST] No Heating or Cooling                                                              |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                  | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | 0                | 0                |
| Notional                                                                                | 28.4              | 165               | 7.9                | 12.1               | 19                | 1             | 3.79          | ----             | ----             |

Key to terms

- Heat dem [MJ/m2]  
Cool dem [MJ/m2]  
Heat con [kWh/m2]  
Cool con [kWh/m2]  
Aux con [kWh/m2]  
Heat SSEFF  
Cool SSEER  
Heat gen SSEFF  
Cool gen SSEER  
ST  
HS  
HFT  
CFT
- = Heating energy demand  
= Cooling energy demand  
= Heating energy consumption  
= Cooling energy consumption  
= Auxiliary energy consumption  
= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)  
= Cooling system seasonal efficiency ratio  
= Heating generator seasonal efficiency  
= Cooling generator seasonal efficiency ratio  
= System type  
= Heat source  
= Heating fuel type  
= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

| Element                                                                                                                                         | U <sub>i</sub> -Typ | U <sub>i</sub> -Min | Surface where the minimum value occurs*                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------|---------------------------------------------------------------------|
| Wall                                                                                                                                            | 0.23                | 0.18                | B1000042:Surf[4]                                                    |
| Floor                                                                                                                                           | 0.2                 | -                   | UNKNOWN                                                             |
| Roof                                                                                                                                            | 0.15                | -                   | UNKNOWN                                                             |
| Windows, roof windows, and rooflights                                                                                                           | 1.5                 | 1.4                 | B1000042:Surf[0]                                                    |
| Personnel doors                                                                                                                                 | 1.5                 | -                   | No Personnel doors in building                                      |
| Vehicle access & similar large doors                                                                                                            | 1.5                 | -                   | No Vehicle access doors in building                                 |
| High usage entrance doors                                                                                                                       | 1.5                 | -                   | No High usage entrance doors in building                            |
| U <sub>i</sub> -Typ = Typical individual element U-values [W/(m²K)]<br>* There might be more than one surface where the minimum U-value occurs. |                     |                     | U <sub>i</sub> -Min = Minimum individual element U-values [W/(m²K)] |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3             |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000006                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | A_1_14.01_3B                        | Prop Type Ref | A_1_14.01_3B |                |            |
| Property                           | A_1_14.01_3B, A_1_14.01_3B          |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 83 B                                | DER           | 17.49        | TER            | 19.32      |
| Environmental                      | 88 B                                | % DER<TER     | 9.45         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.89                                | DFEE          | 44.93        | TFEE           | 49.65      |
| General Requirements Compliance    | Pass                                | % DFEE<TFEE   | 9.50         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 19.32 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 17.49 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)49.6 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)44.9 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | 0.16 (max. 0.25) | 0.16 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinder

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.42  
Maximum 1.5 OK  
MVHR efficiency: 91%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): Slight OK  
Based on:  
Overshading: Average  
Windows facing North: 4.50 m<sup>2</sup>, Overhang twice as wide as window, ratio 2.38  
Windows facing West: 4.50 m<sup>2</sup>, Overhang twice as wide as window, ratio 1.57  
Air change rate: 4.00 ach  
Blinds/curtains: Light-coloured curtain or roller blind, closed 100% of daylight hours

#### 10 Key features

Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 9.0000               | 1.3258           | 11.9318      |                   | (27)          |         |         |         |         |              |
| Heat Loss Floor 1                                                   |               |                | 58.4000              | 0.1600           | 9.3440       |                   | (28a)         |         |         |         |         |              |
| External Wall 1                                                     | 65.4820       | 9.0000         | 56.4820              | 0.1600           | 9.0371       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 123.8820             |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...(30) + (32) = |                  | 30.3129      |                   | (33)          |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 58.4000              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |               |                |                      |                  |              |                   | 8.4973 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                      |                  |              |                   | 38.8102 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 13.2886       | 13.1351        | 12.9815              | 12.2136          | 12.0601      | 11.2922           | 11.2922       | 11.1386 | 11.5993 | 12.0601 | 12.3672 | 12.6744 (38) |
| Heat transfer coeff                                                 | 52.0989       | 51.9453        | 51.7917              | 51.0238          | 50.8703      | 50.1024           | 50.1024       | 49.9488 | 50.4095 | 50.8703 | 51.1774 | 51.4846 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                      |                  |              |                   |               |         |         |         |         | 50.9854 (39) |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.8921        | 0.8895         | 0.8868               | 0.8737           | 0.8711       | 0.8579            | 0.8579        | 0.8553  | 0.8632  | 0.8711  | 0.8763  | 0.8816 (40)  |
| HLP (average)                                                       |               |                |                      |                  |              |                   |               |         |         |         |         | 0.8730 (40)  |
| Days in month                                                       | 31            | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.9361 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 80.1813 (43)                      |
| Daily hot water use                      | Jan 88.1994 | Feb 84.9921 | Mar 81.7849 | Apr 78.5776 | May 75.3704 | Jun 72.1631 | Jul 72.1631 | Aug 75.3704 | Sep 78.5776 | Oct 81.7849 | Nov 84.9921 | Dec 88.1994 (44)                  |
| Energy conte                             | 130.7971    | 114.3960    | 118.0464    | 102.9157    | 98.7501     | 85.2138     | 78.9631     | 90.6114     | 91.6936     | 106.8600    | 116.6460    | 126.6700 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1261.5634 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 19.6196     | 17.1594     | 17.7070     | 15.4374     | 14.8125     | 12.7821     | 11.8445     | 13.5917     | 13.7540     | 16.0290     | 17.4969     | 19.0005 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                  | 145.1872 | 162.1368 | 170.1397 | 181.9468 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                  | 145.1872 | 162.1368 | 170.1397 | 181.9468 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          |               | 1912.4032 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 87.7115  | 77.9786  | 83.4719  | 77.0144  | 77.0559  | 71.1285  | 70.4767  | 74.3497                                   | 73.2830  | 79.7524  | 81.5798  | 86.3392 (65)  |                |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.4336  | 13.7080  | 11.1481  | 8.4398   | 6.3089   | 5.3262   | 5.7552   | 7.4808   | 10.0407  | 12.7490  | 14.8799  | 15.8626 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 117.8918 | 116.0396 | 112.1934 | 106.9645 | 103.5697 | 98.7896  | 94.7267  | 99.9324  | 101.7820 | 107.1941 | 113.3052 | 116.0474 (72) |
| Total internal gains                                                                | 354.2606 | 352.4354 | 341.6128 | 324.2735 | 306.8792 | 289.9617 | 278.8757 | 284.0544 | 292.8803 | 310.4028 | 330.5135 | 345.3931 (73) |

| [Jan]       |          |          |          | Area<br>m <sup>2</sup> | Solar flux<br>Table 6a<br>W/m <sup>2</sup> | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |          |      |
|-------------|----------|----------|----------|------------------------|--------------------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|------|
| North       |          |          |          | 4.5000                 | 10.6334                                    | 0.5000                            | 0.8000                             | 0.7700                       | 13.2641 (74) |          |          |          |      |
| West        |          |          |          | 4.5000                 | 19.6403                                    | 0.5000                            | 0.8000                             | 0.7700                       | 24.4993 (80) |          |          |          |      |
| Solar gains | 37.7634  | 73.2741  | 122.0000 | 184.2966               | 234.2722                                   | 244.1859                          | 230.6378                           | 192.0025                     | 143.5830     | 87.0419  | 46.9107  | 31.2046  | 83)  |
| Total gains | 392.0240 | 425.7095 | 463.6128 | 508.5700               | 541.1514                                   | 534.1476                          | 509.5135                           | 476.0569                     | 436.4634     | 397.4447 | 377.4242 | 376.5977 | (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |                           |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |                           |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec          |
| tau                                                                         | 31.1374 | 31.2294 | 31.3220 | 31.7934 | 31.8894 | 32.3781 | 32.3781 | 32.4777 | 32.1809 | 31.8894                   | 31.6980 | 31.5089      |
| alpha                                                                       | 3.0758  | 3.0820  | 3.0881  | 3.1196  | 3.1260  | 3.1585  | 3.1585  | 3.1652  | 3.1454  | 3.1260                    | 3.1132  | 3.1006       |
| util living area                                                            | 0.9508  | 0.9346  | 0.8998  | 0.8250  | 0.7045  | 0.5459  | 0.4147  | 0.4565  | 0.6670  | 0.8531                    | 0.9295  | 0.9557 (86)  |
| MIT                                                                         | 19.3293 | 19.5256 | 19.8763 | 20.3308 | 20.6890 | 20.9011 | 20.9689 | 20.9576 | 20.8073 | 20.3567                   | 19.7815 | 19.2966 (87) |
| Th 2                                                                        | 20.1742 | 20.1765 | 20.1787 | 20.1899 | 20.1922 | 20.2034 | 20.2034 | 20.2057 | 20.1989 | 20.1922                   | 20.1877 | 20.1832 (88) |
| util rest of house                                                          | 0.9444  | 0.9262  | 0.8867  | 0.8022  | 0.6667  | 0.4905  | 0.3456  | 0.3859  | 0.6141  | 0.8290                    | 0.9192  | 0.9499 (89)  |
| MIT 2                                                                       | 17.9266 | 18.2100 | 18.7126 | 19.3570 | 19.8390 | 20.1099 | 20.1812 | 20.1738 | 20.0029 | 19.4061                   | 18.5894 | 17.8853 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.5856 (91)  |
| MIT                                                                         | 18.7481 | 18.9804 | 19.3941 | 19.9273 | 20.3368 | 20.5733 | 20.6425 | 20.6328 | 20.4740 | 19.9627                   | 19.2875 | 18.7118 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | 0.0000       |
| adjusted MIT                                                                | 18.7481 | 18.9804 | 19.3941 | 19.9273 | 20.3368 | 20.5733 | 20.6425 | 20.6328 | 20.4740 | 19.9627                   | 19.2875 | 18.7118 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9307   | 0.9114   | 0.8722   | 0.7941   | 0.6739   | 0.5169   | 0.3842   | 0.4245   | 0.6331   | 0.8213       | 0.9054   | 0.9369 (94)    |
| Useful gains         | 364.8663 | 388.0093 | 404.3540 | 403.8348 | 364.6552 | 276.0745 | 195.7690 | 202.1032 | 276.3253 | 326.4106     | 341.7025 | 352.8396 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 752.7272 | 731.4118 | 667.8058 | 562.6542 | 439.3569 | 299.2746 | 202.5368 | 211.4234 | 321.3088 | 476.2855     | 623.7264 | 747.1314 (97)  |
| Month fracti         | 1.0000   | 1.0000   |          | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 288.5685 | 230.7664 | 196.0081 | 114.3499 | 55.5781  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 111.5070     | 203.0572 | 293.3531 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1493.1884 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 25.5683 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1493.1884 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1567.8478 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1912.4032 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2008.0234 (310a) |
| Electricity used for heat distribution                                                  | 35.7587 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 93.5130 (330a)   |
| Total electricity for the above, kWh/year                                               | 93.5130 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 272.5626 (332)   |
| Total delivered energy for all uses                                                     | 3941.9468 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3764.0750          | 0.2160                        | 813.0402 (367)           |
| Electrical energy for heat distribution                                                    | 35.7587            | 0.5190                        | 18.5588 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 831.5990 (373)           |
| Space and water heating                                                                    |                    |                               | 831.5990 (376)           |
| Pumps and fans                                                                             | 93.5130            | 0.5190                        | 48.5332 (378)            |
| Energy for lighting                                                                        | 272.5626           | 0.5190                        | 141.4600 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1021.5922 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.4900 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 17.4900 ZC1 |
| Total Floor Area                                                                | TFA | 58.4000     |
| Assumed number of occupants                                                     | N   | 1.9361      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1375 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8333 ZC3  |
| Total CO2 emissions                                                             |     | 37.4609 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 37.4609 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m3 per hour                |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1370 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3870 (18)                |
|                                                      |                              |                      |       |       | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3289 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4194 | 0.4112 | 0.4029 | 0.3618 | 0.3536 | 0.3125 | 0.3125 | 0.3043 | 0.3289 | 0.3536 | 0.3701 | 0.3865 (22b) |
| Effective ac    | 0.5879 | 0.5845 | 0.5812 | 0.5655 | 0.5625 | 0.5488 | 0.5488 | 0.5463 | 0.5541 | 0.5625 | 0.5685 | 0.5747 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                |                         |                            | 9.0000                    | 1.3258                        | 11.9318      |                                | (27)          |
| Heat Loss Floor 1                                           |                         |                            | 58.4000                   | 0.1300                        | 7.5920       |                                | (28a)         |
| External Wall 1                                             | 65.4820                 | 9.0000                     | 56.4820                   | 0.1800                        | 10.1668      |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 123.8820                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            | (26)...(30) + (32) =      |                               | 29.6906      |                                | (33)          |

|                                                                |                            |
|----------------------------------------------------------------|----------------------------|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     | 4.3032 (36)                |
| Total fabric heat loss                                         | (33) + (36) = 33.9938 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 28.3273 | 28.1627 | 28.0015 | 27.2439 | 27.1022 | 26.4424 | 26.4424 | 26.3202 | 26.6965 | 27.1022 | 27.3889 | 27.6887 (38) |
| Heat transfer coeff       | 62.3211 | 62.1565 | 61.9952 | 61.2377 | 61.0960 | 60.4362 | 60.4362 | 60.3140 | 60.6903 | 61.0960 | 61.3827 | 61.6824 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 61.2370 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.0671 | 1.0643 | 1.0616 | 1.0486 | 1.0462 | 1.0349 | 1.0349 | 1.0328 | 1.0392 | 1.0462 | 1.0511 | 1.0562 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0486 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |                    |          |          |          |         |         |         |         |         |          |          |                |
|-------------------------------------------------------------|--------------------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|----------------|
| Assumed occupancy                                           |                    |          |          |          |         |         |         |         |         |          |          | 1.9361 (42)    |
| Average daily hot water use (litres/day)                    |                    |          |          |          |         |         |         |         |         |          |          | 80.1813 (43)   |
|                                                             | Jan                | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec            |
| Daily hot water use                                         | 88.1994            | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849  | 84.9921  | 88.1994 (44)   |
| Energy content (annual)                                     | 130.7971           | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600 | 116.6460 | 126.6700 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                      | Total = Sum(45)m = |          |          |          |         |         |         |         |         |          |          | 1261.5634 (45) |
|                                                             | 19.6196            | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290  | 17.4969  | 19.0005 (46)   |
| Water storage loss:                                         |                    |          |          |          |         |         |         |         |         |          |          |                |
| Store volume                                                |                    |          |          |          |         |         |         |         |         |          |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |                    |          |          |          |         |         |         |         |         |          |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |                    |          |          |          |         |         |         |         |         |          |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |                    |          |          |          |         |         |         |         |         |          |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325            | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325  | 22.5798  | 23.3325 (56)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64) |
| Heat gains from water heating, kWh/month                        | 80.7660  | 71.7052  | 76.5264  | 70.2930  | 70.1103  | 64.4071  | 63.5312  | 67.4042  | 66.5616  | 72.8069  | 74.8583  | 79.3937 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.8278  | 14.0581  | 11.4328  | 8.6554   | 6.4700   | 5.4622   | 5.9022   | 7.6718   | 10.2971  | 13.0746  | 15.2600  | 16.2677 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 108.5564 | 106.7042 | 102.8580 | 97.6291  | 94.2343  | 89.4543  | 85.3914  | 90.5970  | 92.4466  | 97.8587  | 103.9698 | 106.7120 (72) |
| Total internal gains                                                                | 348.3194 | 346.4502 | 335.5622 | 318.1536 | 300.7049 | 283.7623 | 272.6873 | 277.9100 | 286.8014 | 304.3931 | 324.5582 | 339.4628 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
| North       |          |          |          | 4.5000     | 10.6334                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 14.6237 (74)  |
| West        |          |          |          | 4.5000     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 27.0104 (80)  |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |
| Solar gains | 41.6341  | 80.7847  | 134.5050 | 203.1870   | 258.2851                       | 269.2150                          | 254.2782 | 211.6828                           | 158.3003 | 95.9637                      | 51.7190  | 34.4031 (83)  |
| Total gains | 389.9535 | 427.2349 | 470.0671 | 521.3406   | 558.9900                       | 552.9773                          | 526.9655 | 489.5928                           | 445.1017 | 400.3567                     | 376.2772 | 373.8659 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 65.0752 | 65.2475 | 65.4172 | 66.2264 | 66.3801 | 67.1048 | 67.1048 | 67.2407 | 66.8238 | 66.3801 | 66.0700 | 65.7489      |
| alpha                                                                       | 5.3383  | 5.3498  | 5.3611  | 5.4151  | 5.4253  | 5.4737  | 5.4737  | 5.4827  | 5.4549  | 5.4253  | 5.4047  | 5.3833       |
| util living area                                                            | 0.9967  | 0.9939  | 0.9850  | 0.9507  | 0.8512  | 0.6665  | 0.4986  | 0.5555  | 0.8182  | 0.9682  | 0.9933  | 0.9974 (86)  |
| MIT                                                                         | 19.9353 | 20.0589 | 20.2875 | 20.5980 | 20.8486 | 20.9700 | 20.9948 | 20.9910 | 20.9104 | 20.5938 | 20.2148 | 19.9146 (87) |
| Th 2                                                                        | 20.0278 | 20.0301 | 20.0323 | 20.0430 | 20.0450 | 20.0544 | 20.0544 | 20.0561 | 20.0508 | 20.0450 | 20.0410 | 20.0368 (88) |
| util rest of house                                                          | 0.9956  | 0.9919  | 0.9798  | 0.9332  | 0.8030  | 0.5814  | 0.3947  | 0.4473  | 0.7453  | 0.9534  | 0.9906  | 0.9965 (89)  |
| MIT 2                                                                       | 18.6122 | 18.7939 | 19.1265 | 19.5730 | 19.8987 | 20.0348 | 20.0525 | 20.0524 | 19.9801 | 19.5761 | 19.0298 | 18.5887 (90) |
| Living area fraction                                                        | 19.3870 | 19.5347 | 19.8064 | 20.1733 | 20.4550 | 20.5825 | 20.6043 | 20.6021 | 20.5249 | 20.1721 | 19.7237 | 19.3652 (92) |
| MIT                                                                         | 19.3870 | 19.5347 | 19.8064 | 20.1733 | 20.4550 | 20.5825 | 20.6043 | 20.6021 | 20.5249 | 20.1721 | 19.7237 | 19.3652 (93) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.3870 | 19.5347 | 19.8064 | 20.1733 | 20.4550 | 20.5825 | 20.6043 | 20.6021 | 20.5249 | 20.1721 | 19.7237 | 19.3652 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 0.9946   | 0.9906   | 0.9783   | 0.9359   | 0.8252   | 0.6302   | 0.4557   | 0.5108   | 0.7842   | 0.9558   | 0.9895   | 0.9957 (94)    |
| Ext temp.            | 387.8663 | 423.2265 | 459.8671 | 487.9240 | 461.2646 | 348.4954 | 240.1447 | 250.0893 | 349.0471 | 382.6439 | 372.3371 | 372.2507 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Month fracti         | 940.2369 | 909.6420 | 824.9349 | 690.3486 | 534.8924 | 361.5598 | 242.0060 | 253.4432 | 389.9287 | 584.8164 | 774.8784 | 935.4250 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating        | 410.9637 | 326.8713 | 271.6104 | 145.7457 | 54.7791  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 150.4163 | 289.8297 | 419.0017 (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 2069.2179 (98) |
|                      |          |          |          |          |          |          |          |          |          |          |          | 35.4318 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 2213.0673 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 410.9637 | 326.8713 | 271.6104 | 145.7457 | 54.7791  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 150.4163 | 289.8297 | 419.0017 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 439.5334 | 349.5949 | 290.4924 | 155.8778 | 58.5872  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 160.8731 | 309.9783 | 448.1302 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64)   |
| Efficiency of water heater (217)m                                     | 86.9835  | 86.7349  | 86.1409  | 84.7728  | 82.4690  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.7606  | 86.3529  | 79.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 203.9376 | 180.4138 | 191.1302 | 174.5932 | 176.2421 | 163.2903 | 157.3409 | 171.9377 | 171.4103 | 181.0451 | 187.2988 | 198.9629 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2157.6027 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2213.0673 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 279.5239 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4725.1939 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2213.0673          | 0.2160                        | 478.0225 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2157.6027          | 0.2160                        | 466.0422 (264)           |
| Space and water heating                                                                           |                    |                               | 944.0647 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 279.5239           | 0.5190                        | 145.0729 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1128.0626 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.1655 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4841 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6665 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.1655 * 1.00) + 2.4841 + 0.6665, rounded to 2 d.p. |                    |                               | 19.3200 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000050                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | A_1_14.01_3B                        | Prop Type Ref | A_1_14.01_3B |                |            |
| Property                           | A_1_14.01_3B, A_1_14.01_3B          |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 81 B                                | DER           | 21.10        | TER            | 23.02      |
| Environmental                      | 85 B                                | % DER<TER     | 8.35         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.07                                | DFEE          | 58.01        | TFEE           | 66.13      |
| General Requirements Compliance    | Pass                                | % DFEE<TFEE   | 12.28        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 23.02 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 21.10 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)66.1 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)58.0 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | 0.16 (max. 0.25) | 0.16 (max. 0.70) | OK |
| Roof          | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                                                       |    |
|-----------------------------------|-----------------------------------------------------------------------|----|
| Overheating risk (Thames Valley): | Slight                                                                | OK |
| Based on:                         |                                                                       |    |
| Overshading:                      | Average                                                               |    |
| Windows facing South:             | 4.50 m <sup>2</sup> , No overhang                                     |    |
| Air change rate:                  | 4.00 ach                                                              |    |
| Blinds/curtains:                  | Light-coloured curtain or roller blind, closed 100% of daylight hours |    |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m3 per hour               |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K              |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|----------------------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |             |                | 4.5000               | 1.3258           | 5.9659       |                   | (27)                       |         |         |         |         |              |
| Heat Loss Floor 1                                                   |             |                | 58.4000              | 0.1600           | 9.3440       |                   | (28a)                      |         |         |         |         |              |
| External Wall 1                                                     | 65.4820     | 4.5000         | 60.9820              | 0.1600           | 9.7571       |                   | (29a)                      |         |         |         |         |              |
| External Roof 1                                                     | 58.4000     |                | 58.4000              | 0.1600           | 9.3440       |                   | (30)                       |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 182.2820             |                  |              |                   | (31)                       |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  |              | 34.4110           | (33)                       |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |             |                |                      |                  |              |                   | 100.0000 (35)              |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   | 17.9026 (36)               |         |         |         |         |              |
|                                                                     |             |                |                      |                  |              |                   | (33) + (36) = 52.3136 (37) |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 12.5976     | 12.4575        | 12.3175              | 11.6174          | 11.4774      | 10.7773           | 10.7773                    | 10.6372 | 11.0573 | 11.4774 | 11.7574 | 12.0375 (38) |
| Heat transfer coeff                                                 | 64.9111     | 64.7711        | 64.6311              | 63.9310          | 63.7910      | 63.0908           | 63.0908                    | 62.9508 | 63.3709 | 63.7910 | 64.0710 | 64.3511 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |                            |         |         |         |         | 63.8960 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 1.1115      | 1.1091         | 1.1067               | 1.0947           | 1.0923       | 1.0803            | 1.0803                     | 1.0779  | 1.0851  | 1.0923  | 1.0971  | 1.1019 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |                            |         |         |         |         | 1.0941 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31                         | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |         |          |          | 1.9361 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |         |          |          | 80.1813 (43)                      |
| Daily hot water use                      | 88.1994  | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849  | 84.9921  | 88.1994 (44)                      |
| Energy conte                             | 130.7971 | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600 | 116.6460 | 126.6700 (45)                     |
| Energy content (annual)                  |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1261.5634 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |         |         |         |         |         |          |          |                                   |
|                                          | 19.6196  | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290  | 17.4969  | 19.0005 (46)                      |
| Water storage loss:                      |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                             |          |          |          |          |         |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |                |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------------|---------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |                |               |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |                | 0.0152 (51)   |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |                | 1.0294 (52)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |                | 0.6000 (53)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |                | 1.0327 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |                |               |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817        | 32.0144 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |                |               |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817        | 32.0144 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120        | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |                |               |
|                                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397       | 181.9468 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000         | 0.0000 (63)   |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          | 0.0000 (63)    |               |
| Output from w/h                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397       | 181.9468 (64) |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          | 1912.4032 (64) |               |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |                |               |
|                                                                 | 87.7115  | 77.9786  | 83.4719  | 77.0144  | 77.0559  | 71.1285  | 70.4767  | 74.3497                                  | 73.2830  | 79.7524  | 81.5798        | 86.3392 (65)  |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.8436  | 15.8486  | 12.8889  | 9.7577   | 7.2940   | 6.1579   | 6.6539   | 8.6489   | 11.6086  | 14.7398  | 17.2035  | 18.3396 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 117.8918 | 116.0396 | 112.1934 | 106.9645 | 103.5697 | 98.7896  | 94.7267  | 99.9324  | 101.7820 | 107.1941 | 113.3052 | 116.0474 (72) |
| Total internal gains                                                                | 356.6706 | 354.5760 | 343.3536 | 325.5914 | 307.8643 | 290.7934 | 279.7743 | 285.2225 | 294.4482 | 312.3936 | 332.8371 | 347.8701 (73) |

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |  |  | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|--|--|---------------|
| South       |          |          |          |          | 4.5000     | 46.7521                        | 0.3000                            | 0.8000                             |          |          | 0.7700                       |  |  | 34.9911 (78)  |
| Solar gains | 34.9911  | 57.3064  | 72.9982  | 82.5038  | 85.9741    | 82.7384                        | 80.8404                           | 78.5073                            | 76.2553  | 61.8104  | 41.4764                      |  |  | 30.2355 (83)  |
| Total gains | 391.6618 | 411.8824 | 416.3519 | 408.0952 | 393.8384   | 373.5318                       | 360.6148                          | 363.7298                           | 370.7035 | 374.2040 | 374.3135                     |  |  | 378.1056 (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 24.9914 | 25.0455 | 25.0997 | 25.3746 | 25.4303 | 25.7125 | 25.7125 | 25.7697 | 25.5989 | 25.4303 | 25.3191 | 25.2089      |
| alpha                                                                       | 2.6661  | 2.6697  | 2.6733  | 2.6916  | 2.6954  | 2.7142  | 2.7142  | 2.7180  | 2.7066  | 2.6954  | 2.6879  | 2.6806       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9566  | 0.9476  | 0.9331  | 0.9067  | 0.8571  | 0.7585  | 0.6296  | 0.6433  | 0.7873  | 0.8941  | 0.9412  | 0.9603 (86)  |
| MIT                                                                         | 18.8007 | 18.9751 | 19.2960 | 19.7414 | 20.2019 | 20.6224 | 20.8416 | 20.8256 | 20.5450 | 19.9735 | 19.3225 | 18.7662 (87) |
| Th 2                                                                        | 19.9915 | 19.9934 | 19.9954 | 20.0052 | 20.0071 | 20.0169 | 20.0169 | 20.0189 | 20.0130 | 20.0071 | 20.0032 | 19.9993 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9504  | 0.9399  | 0.9225  | 0.8900  | 0.8267  | 0.6975  | 0.5280  | 0.5467  | 0.7341  | 0.8723  | 0.9313  | 0.9545 (89)  |
| MIT 2                                                                       | 17.0563 | 17.3096 | 17.7749 | 18.4210 | 19.0730 | 19.6440 | 19.9013 | 19.8859 | 19.5429 | 18.7559 | 17.8208 | 17.0111 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 18.1196 | 18.3249 | 18.7021 | 19.2259 | 19.7611 | 20.2405 | 20.4745 | 20.4587 | 20.1537 | 19.4981 | 18.7362 | 18.0100 (91) |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |         |         |              |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.1196 | 18.3249 | 18.7021 | 19.2259 | 19.7611 | 20.2405 | 20.4745 | 20.4587 | 20.1537 | 19.4981 | 18.7362 | 18.0100 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9350   | 0.9235   | 0.9054   | 0.8740   | 0.8180   | 0.7128   | 0.5784   | 0.5930   | 0.7426   | 0.8589       | 0.9152   | 0.9399 (94)    |
| Useful gains         | 366.2224 | 380.3625 | 376.9487 | 356.6921 | 322.1585 | 266.2600 | 208.5697 | 215.6786 | 275.2845 | 321.4021     | 342.5661 | 355.3817 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 897.0489 | 869.5451 | 788.6362 | 660.1451 | 514.2282 | 355.8610 | 244.4439 | 255.5005 | 383.6309 | 567.6188     | 745.5461 | 893.2560 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 394.9350 | 328.7307 | 306.2955 | 218.4862 | 142.8998 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 183.1852     | 290.1456 | 400.1785 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 2264.8564 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 38.7818 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 2264.8564 | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 2378.0993 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1912.4032 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2008.0234 | (310a) |
| Electricity used for heat distribution                                                  | 43.8612   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 93.5130   | (330a) |
| Total electricity for the above, kWh/year                                               | 93.5130   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 315.1243  | (332)  |
| Total delivered energy for all uses                                                     | 4794.7599 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 4616.9712          | 0.2160                        | 997.2658 (367)           |
| Electrical energy for heat distribution                                                    | 43.8612            | 0.5190                        | 22.7640 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1020.0298 (373)          |
| Space and water heating                                                                    |                    |                               | 1020.0298 (376)          |
| Pumps and fans                                                                             | 93.5130            | 0.5190                        | 48.5332 (378)            |
| Energy for lighting                                                                        | 315.1243           | 0.5190                        | 163.5495 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1232.1125 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 21.1000 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 21.1000 | ZC1 |
| Total Floor Area                                                                | TFA | 58.4000 |     |
| Assumed number of occupants                                                     | N   | 1.9361  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1375 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8333  | ZC3 |
| Total CO2 emissions                                                             |     | 41.0709 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 41.0709 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1370 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3870 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.2999 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3824 | 0.3749 | 0.3674 | 0.3299 | 0.3224 | 0.2849 | 0.2849 | 0.2774 | 0.2999 | 0.3224 | 0.3374 | 0.3524 (22b) |
|                 | 0.5731 | 0.5703 | 0.5675 | 0.5544 | 0.5520 | 0.5406 | 0.5406 | 0.5385 | 0.5450 | 0.5520 | 0.5569 | 0.5621 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 4.5000                    | 1.3258                        | 5.9659       |                                | (27)          |
| Heat Loss Floor 1                                                   |                         |                            | 58.4000                   | 0.1300                        | 7.5920       |                                | (28a)         |
| External Wall 1                                                     | 65.4820                 | 4.5000                     | 60.9820                   | 0.1800                        | 10.9768      |                                | (29a)         |
| External Roof 1                                                     | 58.4000                 |                            | 58.4000                   | 0.1300                        | 7.5920       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 182.2820                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            |                           | (26)...(30) + (32) =          | 32.1267      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                         |                            |                           |                               |              |                                | 16.7586 (36)  |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 48.8852 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 27.6125                 | 27.4757                    | 27.3416                   | 26.7119                       | 26.5941      | 26.0456                        | 26.0456       |
| Heat transfer coeff                                                 | 76.4978                 | 76.3610                    | 76.2269                   | 75.5971                       | 75.4793      | 74.9308                        | 74.9308       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| HLP                                                                 | 1.3099                  | 1.3076                     | 1.3053                    | 1.2945                        | 1.2925       | 1.2831                         | 1.2831        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                |               |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |          |          |                                   |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |          |          | 1.9361 (42)                       |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |          |          | 80.1813 (43)                      |
| Daily hot water use                                         | 88.1994  | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849  | 84.9921  | 88.1994 (44)                      |
| Energy conte                                                | 130.7971 | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600 | 116.6460 | 126.6700 (45)                     |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1261.5634 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6196  | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290  | 17.4969  | 19.0005 (46)                      |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                                                |          |          |          |          |         |         |         |         |         |          |          | 150.0000 (47)                     |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |          |          | 1.3938 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |          |          | 0.7527 (55)                       |
| Total storage loss                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (56)  |
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64) |
|                                                                 | 80.7660  | 71.7052  | 76.5264  | 70.2930  | 70.1103  | 64.4071  | 63.5312  | 67.4042  | 66.5616  | 72.8069  | 74.8583  | 79.3937 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      | (66) |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.3011  | 16.2549  | 13.2194  | 10.0079  | 7.4810   | 6.3158   | 6.8245   | 8.8707   | 11.9062  | 15.1177  | 17.6446  | 18.8098  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | (71) |
| Water heating gains (Table 5)                                                       | 108.5564 | 106.7042 | 102.8580 | 97.6291  | 94.2343  | 89.4543  | 85.3914  | 90.5970  | 92.4466  | 97.8587  | 103.9698 | 106.7120 | (72) |
| Total internal gains                                                                | 350.7928 | 348.6470 | 337.3487 | 319.5062 | 301.7160 | 284.6159 | 273.6096 | 279.1089 | 288.4105 | 306.4362 | 326.9428 | 342.0049 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |      | Gains<br>W   |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|------|--------------|
| South       |          |          |          |          | 4.5000     | 46.7521                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |      | 64.2962 (78) |
| Solar gains | 64.2962  | 105.3006 | 134.1342 | 151.6008 | 157.9774   | 152.0318                       | 148.5443                          | 144.2571                           | 140.1191 | 113.5765 | 76.2129                      | 55.5578  | (83) |              |
| Total gains | 415.0889 | 453.9475 | 471.4830 | 471.1070 | 459.6934   | 436.6477                       | 422.1539                          | 423.3660                           | 428.5295 | 420.0127 | 403.1557                     | 397.5627 | (84) |              |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 53.0154 | 53.1103 | 53.2037 | 53.6469 | 53.7307 | 54.1240 | 54.1240 | 54.1975 | 53.9718 | 53.7307 | 53.5615 | 53.3858 |              |
| alpha                                                                       | 4.5344  | 4.5407  | 4.5469  | 4.5765  | 4.5820  | 4.6083  | 4.6083  | 4.6132  | 4.5981  | 4.5820  | 4.5708  | 4.5591  |              |
| util living area                                                            | 0.9959  | 0.9931  | 0.9880  | 0.9761  | 0.9452  | 0.8579  | 0.7080  | 0.7279  | 0.8899  | 0.9727  | 0.9923  | 0.9966  | (86)         |
| MIT                                                                         | 19.6497 | 19.7829 | 19.9999 | 20.2873 | 20.5808 | 20.8352 | 20.9516 | 20.9434 | 20.7848 | 20.4099 | 19.9781 | 19.6226 | (87)         |
| Th 2                                                                        | 19.8331 | 19.8349 | 19.8367 | 19.8452 | 19.8467 | 19.8541 | 19.8541 | 19.8555 | 19.8513 | 19.8467 | 19.8435 | 19.8402 | (88)         |
| util rest of house                                                          | 0.9945  | 0.9908  | 0.9835  | 0.9658  | 0.9171  | 0.7767  | 0.5572  | 0.5847  | 0.8248  | 0.9587  | 0.9891  | 0.9955  | (89)         |
| MIT 2                                                                       | 18.0583 | 18.2535 | 18.5702 | 18.9905 | 19.4029 | 19.7287 | 19.8343 | 19.8301 | 19.6704 | 19.1689 | 18.5448 | 18.0238 | (90)         |
| Living area fraction                                                        | 19.0284 | 19.1858 | 19.4417 | 19.7810 | 20.1209 | 20.4032 | 20.5154 | 20.5087 | 20.3497 | 19.9254 | 19.4185 | 18.9984 | (91)         |
| MIT                                                                         | 19.0284 | 19.1858 | 19.4417 | 19.7810 | 20.1209 | 20.4032 | 20.5154 | 20.5087 | 20.3497 | 19.9254 | 19.4185 | 18.9984 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.0284 | 19.1858 | 19.4417 | 19.7810 | 20.1209 | 20.4032 | 20.5154 | 20.5087 | 20.3497 | 19.9254 | 19.4185 | 18.9984 | (93)         |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9931    | 0.9890    | 0.9815   | 0.9651   | 0.9250   | 0.8200   | 0.6494   | 0.6717   | 0.8568   | 0.9599   | 0.9876   | 0.9943    | (94)  |
| Ext temp.            | 412.2450  | 448.9615  | 462.7615 | 454.6659 | 425.2173 | 358.0435 | 274.1559 | 284.3813 | 367.1636 | 403.1680 | 398.1591 | 395.3079  | (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 1126.6872 | 1090.8747 | 986.5078 | 822.5712 | 635.6063 | 434.8394 | 293.3854 | 307.4538 | 469.6177 | 703.8756 | 932.7271 | 1124.1885 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating        | 531.5450  | 431.3657  | 389.6673 | 264.8918 | 156.5294 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 223.7265 | 384.8890 | 542.2872  | (98)  |
| Space heating per m2 |           |           |          |          |          |          |          |          |          |          |          | 2924.9017 | (98)  |
|                      |           |           |          |          |          |          |          |          |          |          |          | 50.0839   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 3128.2372 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 531.5450 | 431.3657 | 389.6673 | 264.8918 | 156.5294 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 223.7265 | 384.8890 | 542.2872 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 568.4974 | 461.3536 | 416.7564 | 283.3068 | 167.4111 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 239.2796 | 411.6459 | 579.9863 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64)   |
| Efficiency of water heater (217)m                                     | 87.5622  | 87.3811  | 87.0338  | 86.3497  | 85.0118  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.8184  | 87.0465  | 79.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 202.5898 | 179.0796 | 189.1695 | 171.4049 | 170.9705 | 163.2903 | 157.3409 | 171.9377 | 171.4103 | 178.8135 | 185.8062 | 197.6690 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2139.4820 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3128.2372 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 323.2038 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5665.9230 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3128.2372          | 0.2160                        | 675.6992 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2139.4820          | 0.2160                        | 462.1281 (264)           |
| Space and water heating                                                                           |                    |                               | 1137.8273 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 323.2038           | 0.5190                        | 167.7428 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1344.4951 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 19.4833 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.8723 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6665 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (19.4833 * 1.00) + 2.8723 + 0.6665, rounded to 2 d.p. |                    |                               | 23.0200 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000078                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.02_2B |                |            |
| Property                           | A_1_14.02_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 82 B                                | DER           | 19.09        | TER            | 21.52      |
| Environmental                      | 87 B                                | % DER<TER     | 11.29        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.97                                | DFEE          | 51.47        | TFEE           | 60.93      |
| General Requirements Compliance    | Pass                                | % DFEE<TFEE   | 15.52        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 21.52 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 19.09 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 60.9 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 51.5 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof             | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings         | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                                                       |    |
|-----------------------------------|-----------------------------------------------------------------------|----|
| Overheating risk (Thames Valley): | Slight                                                                | OK |
| Based on:                         |                                                                       |    |
| Overshading:                      | Average                                                               |    |
| Windows facing North:             | 4.50 m <sup>2</sup> , No overhang                                     |    |
| Windows facing West:              | 4.50 m <sup>2</sup> , No overhang                                     |    |
| Air change rate:                  | 4.00 ach                                                              |    |
| Blinds/curtains:                  | Light-coloured curtain or roller blind, closed 100% of daylight hours |    |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K              |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------------------|----------------|----------------|----------------|----------------|---------------------|
| Opening Type 1 (Uw = 1.40)                                          |                |                | 9.0000               | 1.3258           | 11.9318        |                   | (27)                       |                |                |                |                |                     |
| External Wall 1                                                     | 65.4820        | 9.0000         | 56.4820              | 0.1600           | 9.0371         |                   | (29a)                      |                |                |                |                |                     |
| External Roof 1                                                     | 58.4000        |                | 58.4000              | 0.1600           | 9.3440         |                   | (30)                       |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 123.8820             |                  |                |                   | (31)                       |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 30.3129        |                   | (33)                       |                |                |                |                |                     |
| Party Floor 1                                                       |                |                | 58.4000              |                  |                |                   | (32d)                      |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   | 100.0000 (35)              |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                |                   | 15.9370 (36)               |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                |                   | (33) + (36) = 46.2499 (37) |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                            |                |                |                |                |                     |
| (38)m                                                               | Jan<br>13.2886 | Feb<br>13.1351 | Mar<br>12.9815       | Apr<br>12.2136   | May<br>12.0601 | Jun<br>11.2922    | Jul<br>11.2922             | Aug<br>11.1386 | Sep<br>11.5993 | Oct<br>12.0601 | Nov<br>12.3672 | Dec<br>12.6744 (38) |
| Heat transfer coeff                                                 | 59.5386        | 59.3850        | 59.2314              | 58.4635          | 58.3100        | 57.5421           | 57.5421                    | 57.3885        | 57.8493        | 58.3100        | 58.6171        | 58.9243 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                |                   |                            |                |                |                |                | 58.4252 (39)        |
| HLP                                                                 | Jan<br>1.0195  | Feb<br>1.0169  | Mar<br>1.0142        | Apr<br>1.0011    | May<br>0.9985  | Jun<br>0.9853     | Jul<br>0.9853              | Aug<br>0.9827  | Sep<br>0.9906  | Oct<br>0.9985  | Nov<br>1.0037  | Dec<br>1.0090 (40)  |
| HLP (average)                                                       |                |                |                      |                  |                |                   |                            |                |                |                |                | 1.0004 (40)         |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31                         | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.9361 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 80.1813 (43)                      |
| Daily hot water use                      | Jan 88.1994 | Feb 84.9921 | Mar 81.7849 | Apr 78.5776 | May 75.3704 | Jun 72.1631 | Jul 72.1631 | Aug 75.3704 | Sep 78.5776 | Oct 81.7849 | Nov 84.9921 | Dec 88.1994 (44)                  |
| Energy conte                             | 130.7971    | 114.3960    | 118.0464    | 102.9157    | 98.7501     | 85.2138     | 78.9631     | 90.6114     | 91.6936     | 106.8600    | 116.6460    | 126.6700 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1261.5634 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 19.6196     | 17.1594     | 17.7070     | 15.4374     | 14.8125     | 12.7821     | 11.8445     | 13.5917     | 13.7540     | 16.0290     | 17.4969     | 19.0005 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Solar input                                                     | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397 | 181.9468 (62) |                |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397 | 181.9468 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 1912.4032 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 87.7115  | 77.9786  | 83.4719  | 77.0144  | 77.0559  | 71.1285  | 70.4767  | 74.3497                                  | 73.2830  | 79.7524  | 81.5798  | 86.3392 (65)  |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.4336  | 13.7080  | 11.1481  | 8.4398   | 6.3089   | 5.3262   | 5.7552   | 7.4808   | 10.0407  | 12.7490  | 14.8799  | 15.8626 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 117.8918 | 116.0396 | 112.1934 | 106.9645 | 103.5697 | 98.7896  | 94.7267  | 99.9324  | 101.7820 | 107.1941 | 113.3052 | 116.0474 (72) |
| Total internal gains                                                                | 354.2606 | 352.4354 | 341.6128 | 324.2735 | 306.8792 | 289.9617 | 278.8757 | 284.0544 | 292.8803 | 310.4028 | 330.5135 | 345.3931 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| North       |          |          |          |          | 4.5000     | 10.6334                        | 0.5000                            | 0.8000                             | 0.7700                       |          | 13.2641 (74) |               |
| West        |          |          |          |          | 4.5000     | 19.6403                        | 0.5000                            | 0.8000                             | 0.7700                       |          | 24.4993 (80) |               |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 37.7634  | 73.2741  | 122.0000 | 184.2966 | 234.2722   | 244.1859                       | 230.6378                          | 192.0025                           | 143.5830                     | 87.0419  | 46.9107      | 31.2046 (83)  |
| Total gains | 392.0240 | 425.7095 | 463.6128 | 508.5700 | 541.1514   | 534.1476                       | 509.5135                          | 476.0569                           | 436.4634                     | 397.4447 | 377.4242     | 376.5977 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 27.2466 | 27.3170 | 27.3879 | 27.7476 | 27.8207 | 28.1919 | 28.1919 | 28.2674 | 28.0422 | 27.8207 | 27.6749 | 27.5306      |
| alpha                                                                       | 2.8164  | 2.8211  | 2.8259  | 2.8498  | 2.8547  | 2.8795  | 2.8795  | 2.8845  | 2.8695  | 2.8547  | 2.8450  | 2.8354       |
| util living area                                                            | 0.9547  | 0.9407  | 0.9110  | 0.8474  | 0.7414  | 0.5934  | 0.4612  | 0.5044  | 0.7076  | 0.8717  | 0.9366  | 0.9590 (86)  |
| MIT                                                                         | 19.0133 | 19.2180 | 19.5987 | 20.1083 | 20.5444 | 20.8335 | 20.9409 | 20.9224 | 20.7075 | 20.1606 | 19.5135 | 18.9776 (87) |
| Th 2                                                                        | 20.0671 | 20.0693 | 20.0715 | 20.0824 | 20.0846 | 20.0956 | 20.0956 | 20.0978 | 20.0912 | 20.0846 | 20.0802 | 20.0759 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9484  | 0.9325  | 0.8982  | 0.8248  | 0.7019  | 0.5306  | 0.3779  | 0.4207  | 0.6511  | 0.8479  | 0.9265  | 0.9533 (89)  |
| MIT 2                                                                       | 17.4064 | 17.7025 | 18.2499 | 18.9756 | 19.5688 | 19.9397 | 20.0547 | 20.0409 | 19.7953 | 19.0629 | 18.1394 | 17.3602 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.3475 | 18.5900 | 19.0398 | 19.6389 | 20.1401 | 20.4631 | 20.5737 | 20.5572 | 20.3295 | 19.7057 | 18.9441 | 18.3074 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 18.3475 | 18.5900 | 19.0398 | 19.6389 | 20.1401 | 20.4631 | 20.5737 | 20.5572 | 20.3295 | 19.7057 | 18.9441 | 18.3074 (93) |

#### 8. Space heating requirement

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9334   | 0.9161   | 0.8812   | 0.8124   | 0.7045   | 0.5571   | 0.4230   | 0.4646   | 0.6670   | 0.8364       | 0.9109   | 0.9391 (94)    |
| Useful gains         | 365.9279 | 390.0070 | 408.5433 | 413.1810 | 381.2274 | 297.5817 | 215.5202 | 221.1601 | 291.1096 | 332.4398     | 343.7797 | 353.6780 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 836.3650 | 812.9820 | 742.7499 | 627.8356 | 492.1449 | 337.3753 | 228.6534 | 238.5730 | 360.3723 | 530.9532     | 694.2679 | 831.2692 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 350.0052 | 284.2392 | 248.6497 | 154.5514 | 82.5226  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 147.6940     | 252.3515 | 355.3279 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1875.3415 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 32.1120 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1875.3415 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1969.1086 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1912.4032 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2008.0234 (310a) |
| Electricity used for heat distribution                                                  | 39.7713 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 93.5130 (330a)   |
| Total electricity for the above, kWh/year                                               | 93.5130 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 272.5626 (332)   |
| Total delivered energy for all uses                                                     | 4343.2075 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 4186.4547          | 0.2160                        | 904.2742 (367)           |
| Electrical energy for heat distribution                                                    | 39.7713            | 0.5190                        | 20.6413 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 924.9155 (373)           |
| Space and water heating                                                                    |                    |                               | 924.9155 (376)           |
| Pumps and fans                                                                             | 93.5130            | 0.5190                        | 48.5332 (378)            |
| Energy for lighting                                                                        | 272.5626           | 0.5190                        | 141.4600 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1114.9087 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 19.0900 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 19.0900 ZC1 |
| Total Floor Area                                                                | TFA | 58.4000     |
| Assumed number of occupants                                                     | N   | 1.9361      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1375 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8333 ZC3  |
| Total CO2 emissions                                                             |     | 39.0609 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 39.0609 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1370 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3870 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 2 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3289 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4194 | 0.4112 | 0.4029 | 0.3618 | 0.3536 | 0.3125 | 0.3125 | 0.3043 | 0.3289 | 0.3536 | 0.3701 | 0.3865 (22b) |
| Effective ac    | 0.5879 | 0.5845 | 0.5812 | 0.5655 | 0.5625 | 0.5488 | 0.5488 | 0.5463 | 0.5541 | 0.5625 | 0.5685 | 0.5747 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 9.0000                    | 1.3258                        | 11.9318      |                                | (27)                       |
| External Wall 1                                                | 65.4820                 | 9.0000                     | 56.4820                   | 0.1800                        | 10.1668      |                                | (29a)                      |
| External Roof 1                                                | 58.4000                 |                            | 58.4000                   | 0.1300                        | 7.5920       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 123.8820                  |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 29.6906      |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 13.8264 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 43.5169 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 28.3273 | 28.1627 | 28.0015 | 27.2439 | 27.1022 | 26.4424 | 26.4424 | 26.3202 | 26.6965 | 27.1022 | 27.3889 | 27.6887 (38) |
| Heat transfer coeff       | 71.8442 | 71.6797 | 71.5184 | 70.7609 | 70.6191 | 69.9594 | 69.9594 | 69.8372 | 70.2135 | 70.6191 | 70.9059 | 71.2056 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 70.7602 (39) |
| HLP                       | 1.2302  | 1.2274  | 1.2246  | 1.2117  | 1.2092  | 1.1979  | 1.1979  | 1.1958  | 1.2023  | 1.2092  | 1.2141  | 1.2193 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.2116 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.9361 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 80.1813 (43)   |
| Daily hot water use                                         | 88.1994  | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849            | 84.9921  | 88.1994 (44)   |
| Energy conte                                                | 130.7971 | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600           | 116.6460 | 126.6700 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1261.5634 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6196  | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290            | 17.4969  | 19.0005 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64) |
| Heat gains from water heating, kWh/month                        | 80.7660  | 71.7052  | 76.5264  | 70.2930  | 70.1103  | 64.4071  | 63.5312  | 67.4042  | 66.5616  | 72.8069  | 74.8583  | 79.3937 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.8278  | 14.0581  | 11.4328  | 8.6554   | 6.4700   | 5.4622   | 5.9022   | 7.6718   | 10.2971  | 13.0746  | 15.2600  | 16.2677 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 108.5564 | 106.7042 | 102.8580 | 97.6291  | 94.2343  | 89.4543  | 85.3914  | 90.5970  | 92.4466  | 97.8587  | 103.9698 | 106.7120 (72) |
| Total internal gains                                                                | 348.3194 | 346.4502 | 335.5622 | 318.1536 | 300.7049 | 283.7623 | 272.6873 | 277.9100 | 286.8014 | 304.3931 | 324.5582 | 339.4628 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|---------------|
| North       |          |          |          |          | 4.5000     | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 14.6237 (74)  |
| West        |          |          |          |          | 4.5000     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 27.0104 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |          |               |
| Solar gains | 41.6341  | 80.7847  | 134.5050 | 203.1870 | 258.2851   | 269.2150                       | 254.2782                          | 211.6828                           | 158.3003                     | 95.9637  | 51.7190  | 34.4031 (83)  |
| Total gains | 389.9535 | 427.2349 | 470.0671 | 521.3406 | 558.9900   | 552.9773                       | 526.9655                          | 489.5928                           | 445.1017                     | 400.3567 | 376.2772 | 373.8659 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |              | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |              |
| tau                                                                         | 56.4493 | 56.5789 | 56.7065 | 57.3135 | 57.4286 | 57.9702 | 57.9702 | 58.0716 | 57.7603 | 57.4286 | 57.1963 | 56.9556      |              |
| alpha                                                                       | 4.7633  | 4.7719  | 4.7804  | 4.8209  | 4.8286  | 4.8647  | 4.8647  | 4.8714  | 4.8507  | 4.8286  | 4.8131  | 4.7970       |              |
| util living area                                                            | 0.9968  | 0.9945  | 0.9874  | 0.9621  | 0.8878  | 0.7320  | 0.5656  | 0.6245  | 0.8622  | 0.9750  | 0.9940  | 0.9974 (86)  |              |
| MIT                                                                         | 19.7144 | 19.8437 | 20.0911 | 20.4361 | 20.7447 | 20.9315 | 20.9844 | 20.9753 | 20.8396 | 20.4525 | 20.0278 | 19.6924 (87) |              |
| Th 2                                                                        | 19.8959 | 19.8981 | 19.9003 | 19.9107 | 19.9126 | 19.9217 | 19.9217 | 19.9233 | 19.9182 | 19.9126 | 19.9087 | 19.9046 (88) |              |
| util rest of house                                                          | 0.9957  | 0.9926  | 0.9828  | 0.9472  | 0.8433  | 0.6377  | 0.4363  | 0.4937  | 0.7917  | 0.9623  | 0.9915  | 0.9965 (89)  |              |
| MIT 2                                                                       | 18.1962 | 18.3861 | 18.7469 | 19.2461 | 19.6597 | 19.8757 | 19.9160 | 19.9131 | 19.7872 | 19.2779 | 18.6628 | 18.1701 (90) |              |
| Living area fraction                                                        | 19.0853 | 19.2397 | 19.5341 | 19.9430 | 20.2950 | 20.4940 | 20.5417 | 20.5352 | 20.4035 | 19.9658 | 19.4622 | 19.0616 (92) |              |
| MIT                                                                         | 19.0853 | 19.2397 | 19.5341 | 19.9430 | 20.2950 | 20.4940 | 20.5417 | 20.5352 | 20.4035 | 19.9658 | 19.4622 | 19.0616 (93) |              |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |              |
| adjusted MIT                                                                | 19.0853 | 19.2397 | 19.5341 | 19.9430 | 20.2950 | 20.4940 | 20.5417 | 20.5352 | 20.4035 | 19.9658 | 19.4622 | 19.0616 (93) |              |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |          |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 0.9946    | 0.9911    | 0.9808   | 0.9477   | 0.8607   | 0.6903   | 0.5124   | 0.5705   | 0.8267   | 0.9631   | 0.9902   | 0.9956 (94)    |
| Ext temp.            | 387.8610  | 423.4269  | 461.0642 | 494.0954 | 481.1054 | 381.7040 | 269.9962 | 279.3090 | 367.9771 | 385.5688 | 372.5837 | 372.2183 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1062.2367 | 1027.8655 | 932.1758 | 781.4107 | 606.9750 | 412.3392 | 275.7559 | 288.7876 | 442.5904 | 661.4037 | 876.5529 | 1058.2292 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating        | 501.7355  | 406.1827  | 350.5070 | 206.8670 | 93.6470  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 205.2212 | 362.8578 | 510.3921 (98)  |
| Space heating per m2 |           |           |          |          |          |          |          |          |          |          |          | 2637.4104 (98) |
|                      |           |           |          |          |          |          |          |          |          |          |          | 45.1611 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2820.7597 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 501.7355 | 406.1827 | 350.5070 | 206.8670 | 93.6470  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 205.2212 | 362.8578 | 510.3921  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 536.6155 | 434.4200 | 374.8738 | 221.2481 | 100.1572 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 219.4879 | 388.0832 | 545.8739  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649  | (64)            |
| Efficiency of water heater (217)m                                     | 87.4376  | 87.2466  | 86.7811  | 85.7070  | 83.6766  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.5900  | 86.9073  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 202.8784 | 179.3558 | 189.7202 | 172.6902 | 173.6985 | 163.2903 | 157.3409 | 171.9377 | 171.4103 | 179.2907 | 186.1040 | 197.9590  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2145.6760 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2820.7597 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 279.5239  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5320.9597 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2820.7597          | 0.2160                        | 609.2841 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2145.6760          | 0.2160                        | 463.4660 (264)           |
| Space and water heating                                                                           |                    |                               | 1072.7501 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 279.5239           | 0.5190                        | 145.0729 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1256.7480 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 18.3690 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4841 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6665 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (18.3690 * 1.00) + 2.4841 + 0.6665, rounded to 2 d.p. |                    |                               | 21.5200 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000122                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.02_2B |                |            |
| Property                           | A_1_14.02_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 15.27        | TER            | 16.29      |
| Environmental                      | 89 B                                | % DER<TER     | 6.27         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.78                                | DFEE          | 34.38        | TFEE           | 31.57      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -8.91        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.29 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.27 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)31.6 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)34.4 kWh/m<sup>2</sup>/yrFail  
Excess energy =2.8 kWh/m<sup>2</sup>/yr (8.9%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | 0.16 (max. 0.25) | 0.16 (max. 0.70) | OK |
| Roof          | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinder

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.42  
Maximum 1.5 OK  
MVHR efficiency: 91%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): Slight OK  
Based on:  
Overshading: Average  
Windows facing West: 4.50 m<sup>2</sup>, No overhang  
Air change rate: 4.00 ach  
Blinds/curtains: Light-coloured curtain or roller blind, closed 100% of daylight hours

#### 10 Key features

Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| Opening Type 1 (Uw = 1.40)                                     |                         |                            | 4.5000                    | 1.3258                        | 5.9659       |                                | (27)                       |
| Heat Loss Floor 1                                              |                         |                            | 20.2000                   | 0.1600                        | 3.2320       |                                | (28a)                      |
| External Wall 1                                                | 23.2290                 | 4.5000                     | 18.7290                   | 0.1600                        | 2.9966       |                                | (29a)                      |
| External Roof 1                                                | 20.2000                 |                            | 20.2000                   | 0.1600                        | 3.2320       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 63.6290                   |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 15.4265      |                                | (33)                       |
| Party Floor 1                                                  |                         |                            | 38.1000                   |                               |              |                                | (32d)                      |
| Party Ceilings 1                                               |                         |                            | 38.1000                   |                               |              |                                | (32b)                      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 100.0000 (35)              |
| Thermal bridges (Default value 0.150 * total exposed area)     |                         |                            |                           |                               |              |                                | 9.5444 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 24.9709 (37) |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 12.5976 | 12.4575 | 12.3175 | 11.6174 | 11.4774 | 10.7773 | 10.7773 | 10.6372 | 11.0573 | 11.4774 | 11.7574 | 12.0375 (38) |
| Heat transfer coeff                                                 | 37.5685 | 37.4284 | 37.2884 | 36.5883 | 36.4483 | 35.7482 | 35.7482 | 35.6081 | 36.0282 | 36.4483 | 36.7283 | 37.0084 (39) |
| Average = Sum(39)m / 12 =                                           |         |         |         |         |         |         |         |         |         |         |         | 36.5533 (39) |
| HLP                                                                 | 0.6433  | 0.6409  | 0.6385  | 0.6265  | 0.6241  | 0.6121  | 0.6121  | 0.6097  | 0.6169  | 0.6241  | 0.6289  | 0.6337 (40)  |
| HLP (average)                                                       |         |         |         |         |         |         |         |         |         |         |         | 0.6259 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |         |          |          | 1.9361 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |         |          |          | 80.1813 (43)                      |
| Daily hot water use                      | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Energy conte                             | 88.1994  | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849  | 84.9921  | 88.1994 (44)                      |
| Energy content (annual)                  | 130.7971 | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600 | 116.6460 | 126.6700 (45)                     |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1261.5634 (45) |
|                                          | 19.6196  | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290  | 17.4969  | 19.0005 (46)                      |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|------|
| Water storage loss:                                             |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
| Store volume                                                    |          |          |          |          |          |          |          |                                          |          |          |          | 110.0000 (47) |      |
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |      |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |      |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |      |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |      |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144       | (56) |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144       | (57) |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624       | (59) |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
|                                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397 | 181.9468      | (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | (63) |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          | 0.0000        | (63) |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
|                                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397 | 181.9468      | (64) |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          | 1912.4032     | (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |      |
|                                                                 | 87.7115  | 77.9786  | 83.4719  | 77.0144  | 77.0559  | 71.1285  | 70.4767  | 74.3497                                  | 73.2830  | 79.7524  | 81.5798  | 86.3392       | (65) |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.8436  | 15.8486  | 12.8889  | 9.7577   | 7.2940   | 6.1579   | 6.6539   | 8.6489   | 11.6086  | 14.7398  | 17.2035  | 18.3396 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 117.8198 | 116.0396 | 112.1934 | 106.9645 | 103.5697 | 98.7896  | 94.7267  | 99.9324  | 101.7820 | 107.1941 | 113.3052 | 116.0474 (72) |
| Total internal gains                                                                | 356.6706 | 354.5760 | 343.3536 | 325.5914 | 307.8643 | 290.7934 | 279.7743 | 285.2225 | 294.4482 | 312.3936 | 332.8371 | 347.8701 (73) |

| [Jan        |          |          |          | Area     | Solar flux | g             | FF            |          |          | Access   | Gains        |               |
|-------------|----------|----------|----------|----------|------------|---------------|---------------|----------|----------|----------|--------------|---------------|
|             |          |          |          | m2       | Table 6a   | Specific data | Specific data |          |          | factor   | W            |               |
|             |          |          |          |          | W/m2       | or Table 6b   | or Table 6c   |          |          | Table 6d |              |               |
| West        |          |          |          | 4.5000   | 19.6403    | 0.3000        | 0.8000        |          |          | 0.7700   | 14.6996 (80) |               |
| Solar gains | 14.6996  | 28.7555  | 47.3561  | 69.0661  | 84.6431    | 86.6473       | 82.4917       | 70.8592  | 55.0772  | 34.1208  | 18.3286      | 12.0882 (83)  |
| Total gains | 371.3702 | 383.3314 | 390.7098 | 394.6575 | 392.5074   | 377.4407      | 362.2661      | 356.0817 | 349.5254 | 346.5144 | 351.1657     | 359.9583 (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C)     |         |         |         |         |         |         |         |         |                                       |         |         | 21.0000 (85) |
|---------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, n <sub>li</sub> m, (see Table 9a) |         |         |         |         |         |         |         |         |                                       |         |         |              |
|                                                                                 | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                                   | Oct     | Nov     | Dec          |
| tau                                                                             | 43.1804 | 43.3420 | 43.5047 | 44.3372 | 44.5075 | 45.3792 | 45.3792 | 45.5576 | 45.0264                               | 44.5075 | 44.1682 | 43.8339      |
| alpha                                                                           | 3.8787  | 3.8895  | 3.9003  | 3.9558  | 3.9672  | 4.0253  | 4.0253  | 4.0372  | 4.0018                                | 3.9672  | 3.9445  | 3.9223       |
| util living area                                                                | 0.9421  | 0.9297  | 0.9019  | 0.8413  | 0.7363  | 0.5715  | 0.4255  | 0.4490  | 0.6470                                | 0.8328  | 0.9153  | 0.9470 (86)  |
| MIT                                                                             | 19.9702 | 20.0854 | 20.2999 | 20.5863 | 20.8131 | 20.9509 | 20.9882 | 20.9852 | 20.9158                               | 20.6616 | 20.2941 | 19.9537 (87) |
| Th 2                                                                            | 20.3912 | 20.3933 | 20.3955 | 20.4062 | 20.4083 | 20.4191 | 20.4191 | 20.4213 | 20.4148                               | 20.4083 | 20.4041 | 20.3998 (88) |
| util rest of house                                                              | 0.9358  | 0.9219  | 0.8908  | 0.8231  | 0.7064  | 0.5275  | 0.3722  | 0.3960  | 0.6048                                | 0.8109  | 0.9050  | 0.9412 (89)  |
| MIT 2                                                                           | 18.9944 | 19.1612 | 19.4693 | 19.8800 | 20.1885 | 20.3699 | 20.4098 | 20.4092 | 20.3262                               | 19.9892 | 19.4700 | 18.9770 (90) |
| Living area fraction                                                            |         |         |         |         |         |         |         |         | f <sub>LA</sub> = Living area / (4) = |         |         | 0.6096 (91)  |
| MIT                                                                             | 19.5893 | 19.7246 | 19.9756 | 20.3106 | 20.5693 | 20.7241 | 20.7624 | 20.7603 | 20.6856                               | 20.3991 | 19.9724 | 19.5724 (92) |
| Temperature adjustment                                                          |         |         |         |         |         |         |         |         |                                       |         |         | 0.0000       |
| adjusted MIT                                                                    | 19.5893 | 19.7246 | 19.9756 | 20.3106 | 20.5693 | 20.7241 | 20.7624 | 20.7603 | 20.6856                               | 20.3991 | 19.9724 | 19.5724 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.9261   | 0.9123   | 0.8823   | 0.8200   | 0.7149   | 0.5509   | 0.4039   | 0.4273   | 0.6248   | 0.8106       | 0.8966   | 0.9318 (94)   |
| Useful gains         | 343.9173 | 349.6950 | 344.7350 | 323.6283 | 280.5854 | 207.9490 | 146.3290 | 152.1468 | 218.3757 | 280.8767     | 314.8721 | 335.4245 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 574.3941 | 554.8606 | 502.4837 | 417.4941 | 323.2698 | 218.9236 | 148.7973 | 155.2635 | 237.2672 | 357.1599     | 472.7805 | 568.9059 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 171.4747 | 137.8713 | 117.3651 | 67.5834  | 31.7572  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 56.7547      | 113.6940 | 173.7102 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 870.2106 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 14.9009 (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 870.2106  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 913.7211  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1912.4032 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2008.0234 | (310a) |
| Electricity used for heat distribution                                                  | 29.2174   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 93.5130   | (330a) |
| Total electricity for the above, kWh/year                                               | 93.5130   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 315.1243  | (332)  |
| Total delivered energy for all uses                                                     | 3330.3818 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3075.5205          | 0.2160                        | 664.3124 (367)           |
| Electrical energy for heat distribution                                                    | 29.2174            | 0.5190                        | 15.1639 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 679.4763 (373)           |
| Space and water heating                                                                    |                    |                               | 679.4763 (376)           |
| Pumps and fans                                                                             | 93.5130            | 0.5190                        | 48.5332 (378)            |
| Energy for lighting                                                                        | 315.1243           | 0.5190                        | 163.5495 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 891.5590 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 15.2700 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |         |     |
|---------------------------------------------------------------------------------|---------|-----|
| DER                                                                             | 15.2700 | ZC1 |
| Total Floor Area                                                                | 58.4000 | TFA |
| Assumed number of occupants                                                     | 1.9361  | N   |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190  | EF  |
| CO2 emissions from appliances, equation (L14)                                   | 17.1375 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.8333  | ZC3 |
| Total CO2 emissions                                                             | 35.2409 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000  | ZC7 |
| Net CO2 emissions                                                               | 35.2409 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1370 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.3870 (18)                |
|                                                                           |                 |                      |       |                             | 3 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.7750 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.2999 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3824 | 0.3749 | 0.3674 | 0.3299 | 0.3224 | 0.2849 | 0.2849 | 0.2774 | 0.2999 | 0.3224 | 0.3374 | 0.3524 (22b) |
|                 | 0.5731 | 0.5703 | 0.5675 | 0.5544 | 0.5520 | 0.5406 | 0.5406 | 0.5385 | 0.5450 | 0.5520 | 0.5569 | 0.5621 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 4.5000                    | 1.3258                        | 5.9659       |                                | (27)          |
| Heat Loss Floor 1                                                   |                         |                            | 20.2000                   | 0.1300                        | 2.6260       |                                | (28a)         |
| External Wall 1                                                     | 23.2290                 | 4.5000                     | 18.7290                   | 0.1800                        | 3.3712       |                                | (29a)         |
| External Roof 1                                                     | 20.2000                 |                            | 20.2000                   | 0.1300                        | 2.6260       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 63.6290                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 14.5891      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 3.1815 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 17.7706 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 27.6125                 | 27.4757                    | 27.3416                   | 26.7119                       | 26.5941      | 26.0456                        | 26.0456       |
| Heat transfer coeff                                                 | 45.3831                 | 45.2463                    | 45.1122                   | 44.4825                       | 44.3647      | 43.8162                        | 43.8162       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| HLP                                                                 | 0.7771                  | 0.7748                     | 0.7725                    | 0.7617                        | 0.7597       | 0.7503                         | 0.7503        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                | 0.7485        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              |                                | 0.7539        |
|                                                                     |                         |                            |                           |                               |              |                                | 0.7597        |
|                                                                     |                         |                            |                           |                               |              |                                | 0.7638        |
|                                                                     |                         |                            |                           |                               |              |                                | 0.7680 (40)   |
|                                                                     |                         |                            |                           |                               |              |                                | 0.7617 (40)   |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |          |          |                                   |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |          |          | 1.9361 (42)                       |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |          |          | 80.1813 (43)                      |
| Daily hot water use                                         | 88.1994  | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849  | 84.9921  | 88.1994 (44)                      |
| Energy conte                                                | 130.7971 | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600 | 116.6460 | 126.6700 (45)                     |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1261.5634 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6196  | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290  | 17.4969  | 19.0005 (46)                      |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                                                |          |          |          |          |         |         |         |         |         |          |          | 150.0000 (47)                     |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |          |          | 1.3938 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |          |          | 0.7527 (55)                       |
| Total storage loss                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (56)  |
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64) |
|                                                                 | 80.7660  | 71.7052  | 76.5264  | 70.2930  | 70.1103  | 64.4071  | 63.5312  | 67.4042  | 66.5616  | 72.8069  | 74.8583  | 79.3937 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      | (66) |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.3011  | 16.2549  | 13.2194  | 10.0079  | 7.4810   | 6.3158   | 6.8245   | 8.8707   | 11.9062  | 15.1177  | 17.6446  | 18.8098  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | (71) |
| Water heating gains (Table 5)                                                       | 108.5564 | 106.7042 | 102.8580 | 97.6291  | 94.2343  | 89.4543  | 85.3914  | 90.5970  | 92.4466  | 97.8587  | 103.9698 | 106.7120 | (72) |
| Total internal gains                                                                | 350.7928 | 348.6470 | 337.3487 | 319.5062 | 301.7160 | 284.6159 | 273.6096 | 279.1089 | 288.4105 | 306.4362 | 326.9428 | 342.0049 | (73) |

#### 6. Solar gains

| [Jan]       |  |  | Area<br>m2 |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|--|--|------------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|---------------|
| -----       |  |  | -----      |          | -----                          |          | -----                             |          | -----                              |          | -----                        |          | -----        |               |
| West        |  |  | 4.5000     |          | 19.6403                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 27.0104 (80) |               |
| -----       |  |  | -----      |          | -----                          |          | -----                             |          | -----                              |          | -----                        |          | -----        |               |
| Solar gains |  |  | 27.0104    | 52.8381  | 87.0169                        | 126.9090 | 155.5317                          | 159.2144 | 151.5786                           | 130.2038 | 101.2043                     | 62.6969  | 33.6788      | 22.2121 (83)  |
| Total gains |  |  | 377.8032   | 401.4851 | 424.3656                       | 446.4151 | 457.2477                          | 443.8303 | 425.1881                           | 409.3126 | 389.6148                     | 369.1331 | 360.6216     | 364.2170 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 89.3627 | 89.6329 | 89.8993 | 91.1720 | 91.4141 | 92.5584 | 92.5584 | 92.7735 | 92.1143 | 91.4141 | 90.9256 | 90.4204 |              |
| alpha                                                                       | 6.9575  | 6.9575  | 6.9933  | 7.0781  | 7.0943  | 7.1706  | 7.1706  | 7.1849  | 7.1410  | 7.0943  | 7.0617  | 7.0280  |              |
| util living area                                                            | 0.9960  | 0.9929  | 0.9824  | 0.9418  | 0.8271  | 0.6230  | 0.4526  | 0.4898  | 0.7462  | 0.9508  | 0.9908  | 0.9969  | (86)         |
| MIT                                                                         | 20.3416 | 20.4307 | 20.5903 | 20.7961 | 20.9404 | 20.9932 | 20.9994 | 20.9989 | 20.9774 | 20.8089 | 20.5456 | 20.3252 | (87)         |
| Th 2                                                                        | 20.2732 | 20.2753 | 20.2773 | 20.2867 | 20.2884 | 20.2966 | 20.2966 | 20.2982 | 20.2935 | 20.2884 | 20.2849 | 20.2811 | (88)         |
| util rest of house                                                          | 0.9948  | 0.9907  | 0.9769  | 0.9241  | 0.7839  | 0.5584  | 0.3807  | 0.4159  | 0.6825  | 0.9323  | 0.9875  | 0.9959  | (89)         |
| MIT 2                                                                       | 19.3911 | 19.5221 | 19.7538 | 20.0485 | 20.2312 | 20.2921 | 20.2964 | 20.2977 | 20.2763 | 20.0712 | 19.6972 | 19.3735 | (90)         |
| Living area fraction                                                        | 19.9705 | 20.0760 | 20.2637 | 20.5042 | 20.6635 | 20.7195 | 20.7249 | 20.7252 | 20.7037 | 20.5209 | 20.2143 | 19.9536 | (91)         |
| MIT                                                                         | 19.9705 | 20.0760 | 20.2637 | 20.5042 | 20.6635 | 20.7195 | 20.7249 | 20.7252 | 20.7037 | 20.5209 | 20.2143 | 19.9536 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.9705 | 20.0760 | 20.2637 | 20.5042 | 20.6635 | 20.7195 | 20.7249 | 20.7252 | 20.7037 | 20.5209 | 20.2143 | 19.9536 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9942   | 0.9900   | 0.9768   | 0.9300   | 0.8075   | 0.5976   | 0.4245   | 0.4610   | 0.7204   | 0.9390   | 0.9871   | 0.9954    | (94)  |
| Ext temp.            | 375.6167 | 397.4829 | 414.5143 | 415.1548 | 369.2361 | 265.2240 | 180.5126 | 188.6758 | 280.6923 | 346.6188 | 355.9838 | 362.5338  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 711.1775 | 686.6560 | 620.9130 | 516.1845 | 397.6635 | 268.1322 | 180.7380 | 189.0723 | 290.7428 | 440.1355 | 584.9395 | 706.5844  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating        | 249.6572 | 194.3244 | 153.5606 | 72.7413  | 21.1500  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 69.5764  | 164.8482 | 255.9736  | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 1181.8318 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 20.2368   | (99)  |

#### 8c. Space cooling requirement

Not applicable

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 1263.9912 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 249.6572 | 194.3244 | 153.5606 | 72.7413  | 21.1500  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 69.5764  | 164.8482 | 255.9736 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 267.0131 | 207.8336 | 164.2359 | 77.7982  | 22.6203  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 74.4133  | 176.3082 | 273.7686 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64)   |
| Efficiency of water heater (217)m                                     | 85.7253  | 85.3926  | 84.6287  | 83.0350  | 81.0168  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.8560  | 84.8646  | 79.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 206.9308 | 183.2497 | 194.5455 | 178.2472 | 179.4011 | 163.2903 | 157.3409 | 171.9377 | 171.4103 | 185.2067 | 190.5834 | 201.8153 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2183.9588 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1263.9912 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 323.2038 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3846.1538 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1263.9912          | 0.2160                        | 273.0221 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2183.9588          | 0.2160                        | 471.7351 (264)           |
| Space and water heating                                                                           |                    |                               | 744.7572 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 323.2038           | 0.5190                        | 167.7428 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 951.4250 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.7527 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.8723 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6665 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.7527 * 1.00) + 2.8723 + 0.6665, rounded to 2 d.p. |                    |                               | 16.2900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000150                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.03_1B |                |            |
| Property                           | A_1_14.03_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 15.75        | TER            | 17.32      |
| Environmental                      | 89 B                                | % DER<TER     | 9.04         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.80                                | DFEE          | 37.72        | TFEE           | 39.41      |
| General Requirements Compliance    | Pass                                | % DFEE<TFEE   | 4.27         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 17.32 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.75 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)39.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)37.7 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |        |    |
|-----------------------------------|--------|----|
| Overheating risk (Thames Valley): | Slight | OK |
|-----------------------------------|--------|----|

Based on:

|                       |                                                                       |
|-----------------------|-----------------------------------------------------------------------|
| Overshading:          | Average                                                               |
| Windows facing North: | 4.50 m <sup>2</sup> , Overhang twice as wide as window, ratio 2.38    |
| Windows facing West:  | 4.50 m <sup>2</sup> , No overhang                                     |
| Air change rate:      | 4.00 ach                                                              |
| Blinds/curtains:      | Light-coloured curtain or roller blind, closed 100% of daylight hours |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                                                              |                              |        |        |        | main<br>heating | +      | secondary<br>heating | +      | other  | =      | total                       | m3 per hour          |
|----------------------------------------------------------------------------------------------|------------------------------|--------|--------|--------|-----------------|--------|----------------------|--------|--------|--------|-----------------------------|----------------------|
| Number of chimneys                                                                           |                              |        |        |        | 0               | +      | 0                    | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a)          |
| Number of open flues                                                                         |                              |        |        |        | 0               | +      | 0                    | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b)          |
| Number of intermittent fans                                                                  |                              |        |        |        |                 |        |                      |        |        |        | 0 * 10 =                    | 0.0000 (7a)          |
| Number of passive vents                                                                      |                              |        |        |        |                 |        |                      |        |        |        | 0 * 10 =                    | 0.0000 (7b)          |
| Number of flueless gas fires                                                                 |                              |        |        |        |                 |        |                      |        |        |        | 0 * 40 =                    | 0.0000 (7c)          |
|                                                                                              |                              |        |        |        |                 |        |                      |        |        |        |                             | Air changes per hour |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |        |        |                 |        |                      |        |        |        | 0.0000 / (5) =              | 0.0000 (8)           |
| Pressure test                                                                                |                              |        |        |        |                 |        |                      |        |        |        | Yes                         |                      |
| Measured/design AP50                                                                         |                              |        |        |        |                 |        |                      |        |        |        | 3.0000                      |                      |
| Infiltration rate                                                                            |                              |        |        |        |                 |        |                      |        |        |        | 0.1500                      | (18)                 |
| Number of sides sheltered                                                                    |                              |        |        |        |                 |        |                      |        |        |        | 2                           | (19)                 |
| Shelter factor                                                                               |                              |        |        |        |                 |        |                      |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)          |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |        |        |                 |        |                      |        |        |        | (21) = (18) x (20) =        | 0.1275 (21)          |
|                                                                                              | Jan                          | Feb    | Mar    | Apr    | May             | Jun    | Jul                  | Aug    | Sep    | Oct    | Nov                         | Dec                  |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000 | 4.4000 | 4.3000          | 3.8000 | 3.8000               | 3.7000 | 4.0000 | 4.3000 | 4.5000                      | 4.7000 (22)          |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250 | 1.1000 | 1.0750          | 0.9500 | 0.9500               | 0.9250 | 1.0000 | 1.0750 | 1.1250                      | 1.1750 (22a)         |
| Adj infilt rate                                                                              | 0.1626                       | 0.1594 | 0.1562 | 0.1403 | 0.1371          | 0.1211 | 0.1211               | 0.1179 | 0.1275 | 0.1371 | 0.1434                      | 0.1498 (22b)         |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |        |        |                 |        |                      |        |        |        |                             |                      |
| If mechanical ventilation:                                                                   |                              |        |        |        |                 |        |                      |        |        |        |                             | 0.5000 (23a)         |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |        |        |                 |        |                      |        |        |        |                             | 77.3500 (23c)        |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694 | 0.2535 | 0.2503          | 0.2344 | 0.2344               | 0.2312 | 0.2408 | 0.2503 | 0.2567                      | 0.2631 (25)          |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |             |                | 9.0000               | 1.3258           | 11.9318      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 65.4820     | 9.0000         | 56.4820              | 0.1600           | 9.0371       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 65.4820              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 20.9689      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 58.4000              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 58.4000              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |               |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 30.7912 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 13.2886     | 13.1351        | 12.9815              | 12.2136          | 12.0601      | 11.2922           | 11.2922       | 11.1386 | 11.5993 | 12.0601 | 12.3672 | 12.6744 (38) |
| Heat transfer coeff                                                 | 44.0799     | 43.9263        | 43.7727              | 43.0049          | 42.8513      | 42.0834           | 42.0834       | 41.9299 | 42.3906 | 42.8513 | 43.1584 | 43.4656 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |         |         |         |         | 42.9665 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.7548      | 0.7522         | 0.7495               | 0.7364           | 0.7338       | 0.7206            | 0.7206        | 0.7180  | 0.7259  | 0.7338  | 0.7390  | 0.7443 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |         |         |         |         | 0.7357 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |                                   |          |          |          |         |         |         |         |         |          |              |               |
|------------------------------------------|-----------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|----------|--------------|---------------|
| Assumed occupancy                        |                                   |          |          |          |         |         |         |         |         |          | 1.9361 (42)  |               |
| Average daily hot water use (litres/day) |                                   |          |          |          |         |         |         |         |         |          | 80.1813 (43) |               |
|                                          | Jan                               | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov          | Dec           |
| Daily hot water use                      | 88.1994                           | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849  | 84.9921      | 88.1994 (44)  |
| Energy content (annual)                  | 130.7971                          | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600 | 116.6460     | 126.6700 (45) |
| Distribution loss                        | Total = Sum(45)m = 1261.5634 (45) |          |          |          |         |         |         |         |         |          |              |               |
|                                          | = 0.15 x (45)m                    |          |          |          |         |         |         |         |         |          |              |               |
|                                          | 19.6196                           | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290  | 17.4969      | 19.0005 (46)  |
| Water storage loss:                      |                                   |          |          |          |         |         |         |         |         |          |              |               |
| Store volume                             |                                   |          |          |          |         |         |         |         |         |          |              | 110.0000 (47) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Solar input                                                     | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397 | 181.9468 (62) |                |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 | 186.0739 | 164.3234 | 173.3232 | 156.4094 | 154.0269 | 138.7075 | 134.2399 | 145.8882                                 | 145.1872 | 162.1368 | 170.1397 | 181.9468 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 1912.4032 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 87.7115  | 77.9786  | 83.4719  | 77.0144  | 77.0559  | 71.1285  | 70.4767  | 74.3497                                  | 73.2830  | 79.7524  | 81.5798  | 86.3392 (65)  |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.4336  | 13.7080  | 11.1481  | 8.4398   | 6.3089   | 5.3262   | 5.7552   | 7.4808   | 10.0407  | 12.7490  | 14.8799  | 15.8626 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 117.8918 | 116.0396 | 112.1934 | 106.9645 | 103.5697 | 98.7896  | 94.7267  | 99.9324  | 101.7820 | 107.1941 | 113.3052 | 116.0474 (72) |
| Total internal gains                                                                | 354.2606 | 352.4354 | 341.6128 | 324.2735 | 306.8792 | 289.9617 | 278.8757 | 284.0544 | 292.8803 | 310.4028 | 330.5135 | 345.3931 (73) |

#### 6. Solar gains

|             |          |            |          |                                |          |                              |          |                                    |          |                              |          |               |
|-------------|----------|------------|----------|--------------------------------|----------|------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
| [Jan]       |          | Area<br>m2 |          | Solar flux<br>Table 6a<br>W/m2 |          | Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
| North       |          | 4.5000     |          | 10.6334                        |          | 0.5000                       |          | 0.8000                             |          | 0.7700                       |          | 13.2641 (74)  |
| West        |          | 4.5000     |          | 19.6403                        |          | 0.5000                       |          | 0.8000                             |          | 0.7700                       |          | 24.4993 (80)  |
| Solar gains | 37.7634  | 73.2741    | 122.0000 | 184.2966                       | 234.2722 | 244.1859                     | 230.6378 | 192.0025                           | 143.5830 | 87.0419                      | 46.9107  | 31.2046 (83)  |
| Total gains | 392.0240 | 425.7095   | 463.6128 | 508.5700                       | 541.1514 | 534.1476                     | 509.5135 | 476.0569                           | 436.4634 | 397.4447                     | 377.4242 | 376.5977 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 36.8019 | 36.9305 | 37.0601 | 37.7218 | 37.8570 | 38.5478 | 38.5478 | 38.6890 | 38.2685                   | 37.8570 | 37.5876 | 37.3220      |
| alpha                                                                       | 3.4535  | 3.4620  | 3.4707  | 3.5148  | 3.5238  | 3.5699  | 3.5699  | 3.5793  | 3.5512                    | 3.5238  | 3.5058  | 3.4881       |
| util living area                                                            | 0.9435  | 0.9234  | 0.8799  | 0.7873  | 0.6483  | 0.4815  | 0.3571  | 0.3955  | 0.6065                    | 0.8212  | 0.9166  | 0.9493 (86)  |
| MIT                                                                         | 19.7018 | 19.8854 | 20.1945 | 20.5717 | 20.8295 | 20.9564 | 20.9885 | 20.9835 | 20.9004                   | 20.5737 | 20.0941 | 19.6733 (87) |
| Th 2                                                                        | 20.2927 | 20.2950 | 20.2973 | 20.3088 | 20.3111 | 20.3227 | 20.3227 | 20.3250 | 20.3180                   | 20.3111 | 20.3065 | 20.3019 (88) |
| util rest of house                                                          | 0.9369  | 0.9145  | 0.8662  | 0.7643  | 0.6135  | 0.4361  | 0.3043  | 0.3406  | 0.5595                    | 0.7965  | 0.9056  | 0.9433 (89)  |
| MIT 2                                                                       | 18.5396 | 18.8038 | 19.2444 | 19.7757 | 20.1174 | 20.2811 | 20.3142 | 20.3122 | 20.2163                   | 19.7898 | 19.1144 | 18.5051 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5856 (91)  |
| MIT                                                                         | 19.2202 | 19.4372 | 19.8008 | 20.2419 | 20.5344 | 20.6766 | 20.7090 | 20.7053 | 20.6169                   | 20.2488 | 19.6882 | 19.1892 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.2202 | 19.4372 | 19.8008 | 20.2419 | 20.5344 | 20.6766 | 20.7090 | 20.7053 | 20.6169                   | 20.2488 | 19.6882 | 19.1892 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Utilisation          | 0.9248   | 0.9021   | 0.8554   | 0.7620   | 0.6251   | 0.4601   | 0.3346   | 0.3718   | 0.5806   | 0.7941       | 0.8944   | 0.9318 (94)    |
| Useful gains         | 362.5596 | 384.0190 | 396.5554 | 387.5114 | 338.2718 | 245.7665 | 170.4927 | 176.9950 | 253.4260 | 315.6010     | 337.5726 | 350.9175 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 657.6812 | 638.5660 | 582.2111 | 487.7552 | 378.5670 | 255.7231 | 172.9225 | 180.5211 | 276.2557 | 413.4651     | 543.2852 | 651.5159 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 219.5704 | 171.0556 | 138.1279 | 72.1755  | 29.9796  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 72.8109      | 148.1130 | 223.6452 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1075.4781 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 18.4157 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1075.4781 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1129.2520 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1912.4032 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2008.0234 (310a) |
| Electricity used for heat distribution                                                  | 31.3728 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 93.5130 (330a)   |
| Total electricity for the above, kWh/year                                               | 93.5130 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 272.5626 (332)   |
| Total delivered energy for all uses                                                     | 3503.3509 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3302.3951          | 0.2160                        | 713.3173 (367)           |
| Electrical energy for heat distribution                                                    | 31.3728            | 0.5190                        | 16.2825 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 729.5998 (373)           |
| Space and water heating                                                                    |                    |                               | 729.5998 (376)           |
| Pumps and fans                                                                             | 93.5130            | 0.5190                        | 48.5332 (378)            |
| Energy for lighting                                                                        | 272.5626           | 0.5190                        | 141.4600 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 919.5930 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 15.7500 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 15.7500 ZC1 |
| Total Floor Area                                                                | TFA | 58.4000     |
| Assumed number of occupants                                                     | N   | 1.9361      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1375 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8333 ZC3  |
| Total CO2 emissions                                                             |     | 35.7209 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 35.7209 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.4000 (1b)              | x 2.5000 (2b)                   | = 146.0000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 146.0000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | Air changes per hour                    |
| Pressure test                                                             |                 |                      |       |       | 20.0000 / (5) = 0.1370 (8)              |
| Measured/design AP50                                                      |                 |                      |       |       | Yes                                     |
| Infiltration rate                                                         |                 |                      |       |       | 5.0000                                  |
| Number of sides sheltered                                                 |                 |                      |       |       | 0.3870 (18)                             |
| Shelter factor                                                            |                 |                      |       |       | 2 (19)                                  |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
|                                                                           |                 |                      |       |       | (21) = (18) x (20) = 0.3289 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4194 | 0.4112 | 0.4029 | 0.3618 | 0.3536 | 0.3125 | 0.3125 | 0.3043 | 0.3289 | 0.3536 | 0.3701 | 0.3865 (22b) |
| Effective ac    | 0.5879 | 0.5845 | 0.5812 | 0.5655 | 0.5625 | 0.5488 | 0.5488 | 0.5463 | 0.5541 | 0.5625 | 0.5685 | 0.5747 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 9.0000                    | 1.3258                        | 11.9318      |                                | (27)          |
| External Wall 1                                                     | 65.4820                 | 9.0000                     | 56.4820                   | 0.1800                        | 10.1668      |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 65.4820                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 22.0986      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 3.2741 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 25.3727 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 28.3273                 | 28.1627                    | 28.0015                   | 27.2439                       | 27.1022      | 26.4424                        | 26.4424       |
| Heat transfer coeff                                                 | 53.6999                 | 53.5354                    | 53.3741                   | 52.6166                       | 52.4749      | 51.8151                        | 51.8151       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
|                                                                     | 51.6929                 | 52.0692                    | 52.4749                   | 52.7616                       | 53.0613 (39) | 52.6159 (39)                   |               |
| HLP                                                                 | 0.9195                  | 0.9167                     | 0.9139                    | 0.9010                        | 0.8985       | 0.8872                         | 0.8872        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.8852                         | 0.8916        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.9361 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 80.1813 (43)   |
| Daily hot water use                                         | 88.1994  | 84.9921  | 81.7849  | 78.5776  | 75.3704 | 72.1631 | 72.1631 | 75.3704 | 78.5776 | 81.7849            | 84.9921  | 88.1994 (44)   |
| Energy conte                                                | 130.7971 | 114.3960 | 118.0464 | 102.9157 | 98.7501 | 85.2138 | 78.9631 | 90.6114 | 91.6936 | 106.8600           | 116.6460 | 126.6700 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1261.5634 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6196  | 17.1594  | 17.7070  | 15.4374  | 14.8125 | 12.7821 | 11.8445 | 13.5917 | 13.7540 | 16.0290            | 17.4969  | 19.0005 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (62) |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 80.7660  | 71.7052  | 76.5264  | 70.2930  | 70.1103  | 64.4071  | 63.5312  | 67.4042  | 66.5616  | 72.8069  | 74.8583  | 79.3937 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027  | 96.8027 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.8278  | 14.0581  | 11.4328  | 8.6554   | 6.4700   | 5.4622   | 5.9022   | 7.6718   | 10.2971  | 13.0746  | 15.2600  | 16.2677 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.8944 | 170.6470 | 166.2305 | 156.8284 | 144.9598 | 133.8050 | 126.3530 | 124.6004 | 129.0169 | 138.4190 | 150.2876 | 161.4423 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803  | 32.6803 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 | -77.4421 (71) |
| Water heating gains (Table 5)                                                       | 108.5564 | 106.7042 | 102.8580 | 97.6291  | 94.2343  | 89.4543  | 85.3914  | 90.5970  | 92.4466  | 97.8587  | 103.9698 | 106.7120 (72) |
| Total internal gains                                                                | 348.3194 | 346.4502 | 335.5622 | 318.1536 | 300.7049 | 283.7623 | 272.6873 | 277.9100 | 286.8014 | 304.3931 | 324.5582 | 339.4628 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| North       |          |          |          |          | 4.5000     | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 14.6237 (74) |               |
| West        |          |          |          |          | 4.5000     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 27.0104 (80) |               |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 41.6341  | 80.7847  | 134.5050 | 203.1870 | 258.2851   | 269.2150                       | 254.2782                          | 211.6828                           | 158.3003                     | 95.9637  | 51.7190      | 34.4031 (83)  |
| Total gains | 389.9535 | 427.2349 | 470.0671 | 521.3406 | 558.9900   | 552.9773                       | 526.9655                          | 489.5928                           | 445.1017                     | 400.3567 | 376.2772     | 373.8659 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
| tau                                                                         | 75.5225 | 75.7546 | 75.9835 | 77.0775 | 77.2857 | 78.2698 | 78.2698 | 78.4548 | 77.8878 | 77.2857 | 76.8657 | 76.4315      |
| alpha                                                                       | 6.0348  | 6.0503  | 6.0656  | 6.1385  | 6.1524  | 6.2180  | 6.2180  | 6.2303  | 6.1925  | 6.1524  | 6.1244  | 6.0954       |
| util living area                                                            | 0.9963  | 0.9927  | 0.9803  | 0.9301  | 0.7957  | 0.5894  | 0.4313  | 0.4829  | 0.7546  | 0.9555  | 0.9918  | 0.9971 (86)  |
| MIT                                                                         | 20.1468 | 20.2647 | 20.4739 | 20.7443 | 20.9271 | 20.9904 | 20.9988 | 20.9977 | 20.9605 | 20.7250 | 20.3935 | 20.1276 (87) |
| Th 2                                                                        | 20.1509 | 20.1533 | 20.1557 | 20.1667 | 20.1687 | 20.1784 | 20.1784 | 20.1801 | 20.1746 | 20.1687 | 20.1646 | 20.1602 (88) |
| util rest of house                                                          | 0.9951  | 0.9904  | 0.9740  | 0.9087  | 0.7457  | 0.5182  | 0.3515  | 0.3983  | 0.6835  | 0.9373  | 0.9887  | 0.9962 (89)  |
| MIT 2                                                                       | 19.0122 | 19.1855 | 19.4887 | 19.8729 | 20.1007 | 20.1723 | 20.1779 | 20.1792 | 20.1448 | 19.8556 | 19.3821 | 18.9913 (90) |
| Living area fraction                                                        | 19.6766 | 19.8175 | 20.0656 | 20.3832 | 20.5847 | 20.6514 | 20.6586 | 20.6585 | 20.6225 | 20.3647 | 19.9744 | 19.6567 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6766 | 19.8175 | 20.0656 | 20.3832 | 20.5847 | 20.6514 | 20.6586 | 20.6585 | 20.6225 | 20.3647 | 19.9744 | 19.6567 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | 0.9943   | 0.9893   | 0.9732   | 0.9148   | 0.7717   | 0.5597   | 0.3983   | 0.4479   | 0.7235   | 0.9422   | 0.9878   | 0.9955 (94)    |
| Useful gains         | 387.7180 | 422.6665 | 457.4704 | 476.9399 | 431.3698 | 309.4986 | 209.8802 | 219.2997 | 322.0303 | 377.2109 | 371.7034 | 372.1659 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 825.7252 | 798.6148 | 724.0527 | 604.2092 | 466.2221 | 313.5535 | 210.2986 | 220.1351 | 339.6215 | 512.4019 | 679.2735 | 820.1548 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 325.8773 | 252.6373 | 198.3372 | 91.6340  | 25.9302  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 100.5821 | 221.4505 | 333.3037 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1549.7523 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 26.5369 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1657.4890 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 325.8773 | 252.6373 | 198.3372 | 91.6340  | 25.9302  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 100.5821 | 221.4505 | 333.3037  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 348.5319 | 270.2003 | 212.1254 | 98.0042  | 27.7328  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 107.5745 | 236.8454 | 356.4746  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 177.3920 | 156.4817 | 164.6413 | 148.0076 | 145.3450 | 130.3057 | 125.5580 | 137.2063 | 136.7854 | 153.4549 | 161.7379 | 173.2649  | (64)            |
| Efficiency of water heater                                            | 86.4158  | 86.0851  | 85.3114  | 83.5785  | 81.2544  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.7191  | 85.6525  | 86.5315   | (216)           |
| Fuel for water heating, kWh/month                                     | 205.2773 | 181.7757 | 192.9886 | 177.0880 | 178.8764 | 163.2903 | 157.3409 | 171.9377 | 171.4103 | 183.2974 | 188.8304 | 200.2334  | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          | 2172.3464 | (219)           |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1657.4890 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 279.5239  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4184.3593 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1657.4890          | 0.2160                        | 358.0176 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2172.3464          | 0.2160                        | 469.2268 (264)           |
| Space and water heating                                                                           |                    |                               | 827.2445 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 279.5239           | 0.5190                        | 145.0729 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1011.2424 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.1651 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4841 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6665 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.1651 * 1.00) + 2.4841 + 0.6665, rounded to 2 d.p. |                    |                               | 17.3200 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000194                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.03_1B |                |            |
| Property                           | A_1_14.03_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.54        | TER            | 15.39      |
| Environmental                      | 91 B                                | % DER<TER     | 18.51        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.66                                | DFEE          | 23.20        | TFEE           | 29.82      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 22.19        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 57 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.39 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.54 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)29.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)23.2 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 11.59 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.6900 (1b)              | x 2.5000 (2b)                   | = 141.7250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 141.7250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K              |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|----------------------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |             |                | 11.5900              | 0.9615           | 11.1442      |                   | (27)                       |         |         |         |         |              |
| External Wall 1                                                     | 18.0683     | 11.5920        | 6.4763               | 0.1600           | 1.0362       |                   | (29a)                      |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 18.0663              |                  |              |                   | (31)                       |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 12.1804      |                   | (33)                       |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 56.6900              |                  |              |                   | (32d)                      |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 56.6900              |                  |              |                   | (32b)                      |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 100.0000 (35)              |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   | (33) + (36) = 14.8904 (37) |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 12.2287     | 12.0928        | 11.9569              | 11.2772          | 11.1413      | 10.4617           | 10.4617                    | 10.3258 | 10.7335 | 11.1413 | 11.4132 | 11.6850 (38) |
| Heat transfer coeff                                                 | 27.1191     | 26.9832        | 26.8472              | 26.1676          | 26.0317      | 25.3521           | 25.3521                    | 25.2162 | 25.6239 | 26.0317 | 26.3035 | 26.5754 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |                            |         |         |         |         | 26.1336 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.4784      | 0.4760         | 0.4736               | 0.4616           | 0.4592       | 0.4472            | 0.4472                     | 0.4448  | 0.4520  | 0.4592  | 0.4640  | 0.4688 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |                            |         |         |         |         | 0.4610 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31                         | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |         |          |          | 1.8867 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |         |          |          | 79.0086 (43)                      |
| Daily hot water use                      | 86.9094  | 83.7491  | 80.5887  | 77.4284  | 74.2680 | 71.1077 | 71.1077 | 74.2680 | 77.4284 | 80.5887  | 83.7491  | 86.9094 (44)                      |
| Energy conte                             | 128.8842 | 112.7229 | 116.3199 | 101.4105 | 97.3058 | 83.9675 | 77.8083 | 89.2861 | 90.3525 | 105.2971 | 114.9400 | 124.8174 (45)                     |
| Energy content (annual)                  |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1243.1123 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |         |         |         |         |         |          |          |                                   |
|                                          | 19.3326  | 16.9084  | 17.4480  | 15.2116  | 14.5959 | 12.5951 | 11.6712 | 13.3929 | 13.5529 | 15.7946  | 17.2410  | 18.7226 (46)                      |
| Water storage loss:                      |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                             |          |          |          |          |         |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |                |              |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|----------------|--------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |                |              |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          |                | 0.0152 (51)  |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          |                | 1.0294 (52)  |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          |                | 0.6000 (53)  |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          |                | 1.0327 (55)  |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |                |              |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144        | 32.0144 (56) |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |                |              |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)   |              |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (58)   |              |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |                |              |
|                                                                 | 184.1610 | 162.6503 | 171.5967 | 154.9042 | 152.5826 | 137.4612 | 133.0851 | 144.5629                                 | 143.8462 | 160.5739 | 168.4337 | 180.0942 (59)  |              |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |              |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          | 0.0000 (63)    |              |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |                |              |
|                                                                 | 184.1610 | 162.6503 | 171.5967 | 154.9042 | 152.5826 | 137.4612 | 133.0851 | 144.5629                                 | 143.8462 | 160.5739 | 168.4337 | 180.0942 (64)  |              |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          | 1893.9521 (64) |              |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |                |              |
|                                                                 | 87.0754  | 77.4223  | 82.8978  | 76.5140  | 76.5756  | 70.7141  | 70.0927  | 73.9091                                  | 72.8371  | 79.2327  | 81.0125  | 85.7232 (65)   |              |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.6679  | 13.0279  | 10.5950  | 8.0211   | 5.9959   | 5.0620   | 5.4696   | 7.1096   | 9.5425   | 12.1164  | 14.1416  | 15.0755 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 164.5289 | 166.2362 | 161.9339 | 152.7747 | 141.2129 | 130.3465 | 123.0870 | 121.3797 | 125.6821 | 134.8412 | 146.4030 | 157.2694 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 (71) |
| Water heating gains (Table 5)                                                       | 117.0369 | 115.2118 | 111.4218 | 106.2694 | 102.9242 | 98.2141  | 94.2106  | 99.3402  | 101.1627 | 106.4956 | 112.5174 | 115.2194 (72) |
| Total internal gains                                                                | 347.5338 | 345.7760 | 335.2508 | 318.3653 | 301.4332 | 284.9227 | 274.0674 | 279.1297 | 287.6874 | 304.7534 | 324.3621 | 338.8645 (73) |

| [Jan        |          |          |          | Area     | Solar flux | g             | FF            |               |               | Access   |          |          | Gains |
|-------------|----------|----------|----------|----------|------------|---------------|---------------|---------------|---------------|----------|----------|----------|-------|
|             |          |          |          | m2       | Table 6a   | Specific data | Specific data | Specific data | Specific data | factor   |          |          | W     |
|             |          |          |          |          | W/m2       | or Table 6b   | or Table 6b   | or Table 6c   | or Table 6c   | Table 6d |          |          |       |
| Northeast   |          |          |          | 11.5920  | 11.2829    | 0.5000        | 0.8000        | 0.7700        | 36.2555       | (75)     |          |          |       |
| Solar gains | 36.2555  | 73.7991  | 132.9625 | 218.3627 | 293.5223   | 312.9259      | 292.7357      | 233.3723      | 162.0169      | 90.1884  | 45.6188  | 29.6081  | (83)  |
| Total gains | 383.7893 | 419.5751 | 468.2133 | 536.7280 | 594.9555   | 597.8485      | 566.8031      | 512.5020      | 449.7044      | 394.9418 | 369.9809 | 368.4726 | (84)  |

| Temperature during heating periods in the living area from Table 9, Th1 (C)    |         |         |         |         |         |         |         |         |                                        |         |         | 21.0000 (85) |
|--------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|----------------------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, n <sub>li,m</sub> (see Table 9a) |         |         |         |         |         |         |         |         |                                        |         |         |              |
|                                                                                | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                                    | Oct     | Nov     | Dec          |
| tau                                                                            | 58.0669 | 58.3594 | 58.6549 | 60.1783 | 60.4925 | 62.1141 | 62.1141 | 62.4489 | 61.4551                                | 60.4925 | 59.8673 | 59.2549      |
| alpha                                                                          | 4.8711  | 4.8906  | 4.9103  | 5.0119  | 5.0328  | 5.1409  | 5.1409  | 5.1633  | 5.0970                                 | 5.0328  | 4.9912  | 4.9503       |
| util living area                                                               | 0.8904  | 0.8443  | 0.7462  | 0.5720  | 0.4043  | 0.2712  | 0.1968  | 0.2262  | 0.3911                                 | 0.6496  | 0.8281  | 0.9008 (86)  |
| MIT                                                                            | 20.5435 | 20.6704 | 20.8357 | 20.9602 | 20.9935 | 20.9994 | 20.9999 | 20.9998 | 20.9962                                | 20.9412 | 20.7551 | 20.5275 (87) |
| Th 2                                                                           | 20.5407 | 20.5429 | 20.5451 | 20.5562 | 20.5584 | 20.5695 | 20.5695 | 20.5717 | 20.5650                                | 20.5584 | 20.5540 | 20.5495 (88) |
| util rest of house                                                             | 0.8814  | 0.8327  | 0.7303  | 0.5533  | 0.3856  | 0.2530  | 0.1775  | 0.2052  | 0.3669                                 | 0.6270  | 0.8140  | 0.8925 (89)  |
| MIT 2                                                                          | 19.9260 | 20.1050 | 20.3334 | 20.5075 | 20.5511 | 20.5689 | 20.5694 | 20.5715 | 20.5611                                | 20.4879 | 20.2348 | 19.9112 (90) |
| Living area fraction                                                           |         |         |         |         |         |         |         |         | f <sub>LiA</sub> = Living area / (4) = |         |         | 0.4967 (91)  |
| MIT                                                                            | 20.2327 | 20.3859 | 20.5829 | 20.7324 | 20.7709 | 20.7827 | 20.7832 | 20.7843 | 20.7772                                | 20.7131 | 20.4933 | 20.2174 (92) |
| Temperature adjustment                                                         |         |         |         |         |         |         |         |         |                                        |         |         | 0.0000       |
| adjusted MIT                                                                   | 20.2327 | 20.3859 | 20.5829 | 20.7324 | 20.7709 | 20.7827 | 20.7832 | 20.7843 | 20.7772                                | 20.7131 | 20.4933 | 20.2174 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8748   | 0.8285   | 0.7317   | 0.5608   | 0.3946   | 0.2620   | 0.1871   | 0.2157   | 0.3787   | 0.6350       | 0.8120   | 0.8859 (94)   |
| Useful gains         | 335.7569 | 347.6313 | 342.5794 | 300.9941 | 234.7643 | 156.6264 | 106.0384 | 110.5232 | 170.3247 | 250.7815     | 300.4372 | 326.4121 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |              |          |               |
|                      | 432.0810 | 417.8577 | 378.0869 | 309.6254 | 236.1300 | 156.7450 | 106.0540 | 110.5548 | 171.0963 | 263.2604     | 352.2899 | 425.6680 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |              |          |               |
|                      | 71.6651  | 47.1922  | 26.4176  | 6.2145   | 1.0161   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 9.2843       | 37.3339  | 73.8464 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 272.9702 (99) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 4.8151 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 272.9702  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 286.6187  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1893.9521 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1988.6497 | (310a) |
| Electricity used for heat distribution                                                  | 22.7527   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 90.7749   | (330a) |
| Total electricity for the above, kWh/year                                               | 90.7749   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 259.0392  | (332)  |
| Total delivered energy for all uses                                                     | 2625.0824 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2395.0194          | 0.2160                        | 517.3242 (367)           |
| Electrical energy for heat distribution                                                    | 22.7527            | 0.5190                        | 11.8086 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 529.1328 (373)           |
| Space and water heating                                                                    |                    |                               | 529.1328 (376)           |
| Pumps and fans                                                                             | 90.7749            | 0.5190                        | 47.1122 (378)            |
| Energy for lighting                                                                        | 259.0392           | 0.5190                        | 134.4413 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 710.6863 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.5400 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 12.5400 | ZC1 |
| Total Floor Area                                                                | TFA | 56.6900 |     |
| Assumed number of occupants                                                     | N   | 1.8867  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1982 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8979  | ZC3 |
| Total CO2 emissions                                                             |     | 32.6360 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 32.6360 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.6900 (1b)              | x 2.5000 (2b)                   | = 141.7250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 141.7250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Air changes per hour                                                      |                 |                      |                             |                 |                         |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1411 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3911 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3031 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3865 | 0.3789 | 0.3713 | 0.3334 | 0.3259 | 0.2880 | 0.2880 | 0.2804 | 0.3031 | 0.3259 | 0.3410 | 0.3562 (22b) |
| Effective ac    | 0.5747 | 0.5718 | 0.5689 | 0.5556 | 0.5531 | 0.5415 | 0.5415 | 0.5393 | 0.5459 | 0.5531 | 0.5581 | 0.5634 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 11.5900              | 1.3258           | 15.3655      |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 18.0683     | 11.5920        | 6.4763               | 0.1800           | 1.1657       |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 18.0663              |                  |              |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  |              | 16.5313           |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |                      |                  |              |                   |               | 0.9033 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 17.4346       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 26.8774     | 26.7418        | 26.6088              | 25.9844          | 25.8676      | 25.3237           | 25.3237       | 25.2230       | 25.5332 | 25.8676 | 26.1039 | 26.3510 | (38) |
| Heat transfer coeff                                                 | 44.3120     | 44.1764        | 44.0434              | 43.4190          | 43.3021      | 42.7583           | 42.7583       | 42.6576       | 42.9678 | 43.3021 | 43.5385 | 43.7856 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |               |         |         |         | 43.4184 | (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.7817      | 0.7793         | 0.7769               | 0.7659           | 0.7638       | 0.7542            | 0.7542        | 0.7525        | 0.7579  | 0.7638  | 0.7680  | 0.7724  | (40) |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |               |         |         |         | 0.7659  | (40) |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.8867 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 79.0086 (43)   |
| Daily hot water use                                         | 86.9094  | 83.7491  | 80.5887  | 77.4284  | 74.2680 | 71.1077 | 71.1077 | 74.2680 | 77.4284 | 80.5887            | 83.7491  | 86.9094 (44)   |
| Energy conte                                                | 128.8842 | 112.7229 | 116.3199 | 101.4105 | 97.3058 | 83.9675 | 77.8083 | 89.2861 | 90.3525 | 105.2971           | 114.9400 | 124.8174 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1243.1123 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.3326  | 16.9084  | 17.4480  | 15.2116  | 14.5959 | 12.5951 | 11.6712 | 13.3929 | 13.5529 | 15.7946            | 17.2410  | 18.7226 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810 | 135.4443 | 151.8920 | 160.0319 | 171.4123 (62) |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810 | 135.4443 | 151.8920 | 160.0319 | 171.4123 (64) |
| Heat gains from water heating, kWh/month                        | 80.1299  | 71.1489  | 75.9523  | 69.7925  | 69.6301  | 63.9927  | 63.1472  | 66.9636  | 66.1157  | 72.2872  | 74.2910  | 78.7777 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.7395  | 13.0915  | 10.6467  | 8.0602   | 6.0251   | 5.0867   | 5.4963   | 7.1443   | 9.5891   | 12.1756  | 14.2107  | 15.1491  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 164.5289 | 166.2362 | 161.9339 | 152.7747 | 141.2129 | 130.3465 | 123.0870 | 121.3797 | 125.6821 | 134.8412 | 146.4030 | 157.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | (71) |
| Water heating gains (Table 5)                                                       | 107.7015 | 105.8764 | 102.0864 | 96.9340  | 93.5889  | 88.8787  | 84.8752  | 90.0048  | 91.8273  | 97.1602  | 103.1820 | 105.8840 | (72) |
| Total internal gains                                                                | 341.2700 | 339.5042 | 328.9671 | 312.0691 | 295.1271 | 278.6120 | 267.7587 | 272.8290 | 281.3986 | 298.4771 | 318.0958 | 332.6027 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |          | Gains<br>W   |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|----------|--------------|
| -----       |          |          |          |            |                                |                                   |                                    | -----    |          |                              |          |          |              |
| Northeast   |          |          |          | 11.5920    | 11.2829                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |          | 39.9717 (75) |
| -----       |          |          |          |            |                                |                                   |                                    | -----    |          |                              |          |          |              |
| Solar gains | 39.9717  | 81.3635  | 146.5912 | 240.7449   | 323.6084                       | 345.0008                          | 322.7411                           | 257.2930 | 178.6237 | 99.4327                      | 50.2947  | 32.6429  | (83)         |
| Total gains | 381.2417 | 420.8677 | 475.5583 | 552.8140   | 618.7354                       | 623.6128                          | 590.4999                           | 530.1220 | 460.0223 | 397.9098                     | 368.3905 | 365.2456 | (84)         |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 88.8429 | 89.1157 | 89.3847 | 90.6702 | 90.9148 | 92.0712 | 92.0712 | 92.2885 | 91.6223                   | 90.9148 | 90.4213 | 89.9110 |              |
| alpha                                                                       | 6.9229  | 6.9410  | 6.9590  | 7.0447  | 7.0610  | 7.1381  | 7.1381  | 7.1526  | 7.1082                    | 7.0610  | 7.0281  | 6.9941  |              |
| util living area                                                            | 0.9951  | 0.9891  | 0.9637  | 0.8523  | 0.6396  | 0.4381  | 0.3185  | 0.3700  | 0.6341                    | 0.9230  | 0.9878  | 0.9962  | (86)         |
| MIT                                                                         | 20.3596 | 20.4760 | 20.6795 | 20.9034 | 20.9875 | 20.9992 | 20.9999 | 20.9998 | 20.9915                   | 20.8520 | 20.5704 | 20.3387 | (87)         |
| Th 2                                                                        | 20.2693 | 20.2713 | 20.2734 | 20.2830 | 20.2848 | 20.2932 | 20.2932 | 20.2947 | 20.2899                   | 20.2848 | 20.2811 | 20.2773 | (88)         |
| util rest of house                                                          | 0.9936  | 0.9859  | 0.9536  | 0.8216  | 0.5941  | 0.3901  | 0.2674  | 0.3133  | 0.5731                    | 0.8977  | 0.9837  | 0.9951  | (89)         |
| MIT 2                                                                       | 19.4140 | 19.5841 | 19.8747 | 20.1785 | 20.2740 | 20.2927 | 20.2931 | 20.2946 | 20.2839                   | 20.1225 | 19.7295 | 19.3901 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4967  | (91)         |
| MIT                                                                         | 19.8837 | 20.0271 | 20.2745 | 20.5386 | 20.6284 | 20.6437 | 20.6442 | 20.6449 | 20.6354                   | 20.4849 | 20.1472 | 19.8613 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.8837 | 20.0271 | 20.2745 | 20.5386 | 20.6284 | 20.6437 | 20.6442 | 20.6449 | 20.6354                   | 20.4849 | 20.1472 | 19.8613 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |       |
| Useful gains         | 0.9926   | 0.9847   | 0.9536   | 0.8330   | 0.6162   | 0.4139   | 0.2928   | 0.3415   | 0.6032   | 0.9055   | 0.9827   | 0.9943   | (94)  |
| Ext temp.            | 378.4214 | 414.4111 | 453.5039 | 460.5182 | 381.2574 | 258.1350 | 172.9052 | 181.0234 | 277.4742 | 360.2963 | 362.0227 | 363.1482 | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000   | (96)  |
| Month fracti         | 690.5439 | 668.2622 | 606.6750 | 505.3355 | 386.6204 | 258.4164 | 172.9243 | 181.0783 | 280.8106 | 428.0366 | 568.0561 | 685.7391 | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | (97a) |
| Space heating        | 232.2192 | 170.5880 | 113.9593 | 32.2685  | 3.9901   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.3988  | 148.3441 | 240.0076 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 991.7755 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 17.4947  | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1060.7224 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 232.2192 | 170.5880 | 113.9593 | 32.2685  | 3.9901   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.3988  | 148.3441 | 240.0076  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 248.3627 | 182.4470 | 121.8816 | 34.5117  | 4.2675   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 53.9024  | 158.6568 | 256.6926  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Water heating requirement                                             | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810 | 135.4443 | 151.8920 | 160.0319 | 171.4123  | (64)            |
| Efficiency of water heater                                            | 85.5620  | 85.0731  | 83.8820  | 81.5402  | 80.0554  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2220  | 84.6124  | 85.7117   | (216)           |
| (217)m                                                                | 85.5620  | 85.0731  | 83.8820  | 81.5402  | 80.0554  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2220  | 84.6124  | 85.7117   | (217)           |
| Fuel for water heating, kWh/month                                     | 205.0899 | 181.9714 | 194.2191 | 179.6690 | 179.7515 | 161.7285 | 155.8937 | 170.2770 | 169.7297 | 184.7341 | 189.1353 | 199.9870  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2172.1862 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1060.7224 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 260.3037  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3568.2124 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1060.7224          | 0.2160                        | 229.1160 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2172.1862          | 0.2160                        | 469.1922 (264)           |
| Space and water heating                                                                           |                    |                               | 698.3083 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 260.3037           | 0.5190                        | 135.0976 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 872.3309 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.3180 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3831 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6866 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.3180 * 1.00) + 2.3831 + 0.6866, rounded to 2 d.p. |                    |                               | 15.3900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000222                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.04_1B |                |            |
| Property                           | A_2_14.04_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 13.55        | TER            | 15.39      |
| Environmental                      | 91 B                                | % DER<TER     | 11.94        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.69                                | DFEE          | 28.14        | TFEE           | 29.82      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 5.62         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 57 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.39 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 13.55 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)29.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)28.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 11.59 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.6900 (1b)              | x 2.5000 (2b)                   | = 141.7250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 141.7250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K              |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|----------------------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |             |                | 11.5900              | 1.3258           | 15.3655      |                   | (27)                       |         |         |         |         |              |
| External Wall 1                                                     | 18.0683     | 11.5920        | 6.4763               | 0.1600           | 1.0362       |                   | (29a)                      |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 18.0663              |                  |              |                   | (31)                       |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 16.4017      |                   | (33)                       |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 56.6900              |                  |              |                   | (32d)                      |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 56.6900              |                  |              |                   | (32b)                      |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 100.0000 (35)              |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   | (33) + (36) = 19.1117 (37) |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 12.2287     | 12.0928        | 11.9569              | 11.2772          | 11.1413      | 10.4617           | 10.4617                    | 10.3258 | 10.7335 | 11.1413 | 11.4132 | 11.6850 (38) |
| Heat transfer coeff                                                 | 31.3404     | 31.2045        | 31.0685              | 30.3889          | 30.2530      | 29.5734           | 29.5734                    | 29.4375 | 29.8452 | 30.2530 | 30.5248 | 30.7967 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |                            |         |         |         |         | 30.3549 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.5528      | 0.5504         | 0.5480               | 0.5361           | 0.5337       | 0.5217            | 0.5217                     | 0.5193  | 0.5265  | 0.5337  | 0.5385  | 0.5432 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |                            |         |         |         |         | 0.5355 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31                         | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |         |          |          | 1.8867 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |         |          |          | 79.0086 (43)                      |
| Daily hot water use                      | 86.9094  | 83.7491  | 80.5887  | 77.4284  | 74.2680 | 71.1077 | 71.1077 | 74.2680 | 77.4284 | 80.5887  | 83.7491  | 86.9094 (44)                      |
| Energy conte                             | 128.8842 | 112.7229 | 116.3199 | 101.4105 | 97.3058 | 83.9675 | 77.8083 | 89.2861 | 90.3525 | 105.2971 | 114.9400 | 124.8174 (45)                     |
| Energy content (annual)                  |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1243.1123 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |         |         |         |         |         |          |          |                                   |
|                                          | 19.3326  | 16.9084  | 17.4480  | 15.2116  | 14.5959 | 12.5951 | 11.6712 | 13.3929 | 13.5529 | 15.7946  | 17.2410  | 18.7226 (46)                      |
| Water storage loss:                      |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                             |          |          |          |          |         |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)    |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)   |
| Primary loss                                                    |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 184.1610 | 162.6503 | 171.5967 | 154.9042 | 152.5826 | 137.4612 | 133.0851 | 144.5629 | 143.8462 | 160.5739 | 168.4337 | 180.0942 (62)  |
| Solar input                                                     |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 184.1610 | 162.6503 | 171.5967 | 154.9042 | 152.5826 | 137.4612 | 133.0851 | 144.5629 | 143.8462 | 160.5739 | 168.4337 | 180.0942 (64)  |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 1893.9521 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 87.0754  | 77.4223  | 82.8978  | 76.5140  | 76.5756  | 70.7141  | 70.0927  | 73.9091  | 72.8371  | 79.2327  | 81.0125  | 85.7232 (65)   |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.6679  | 13.0279  | 10.5950  | 8.0211   | 5.9959   | 5.0620   | 5.4696   | 7.1096   | 9.5425   | 12.1164  | 14.1416  | 15.0755 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 164.5289 | 166.2362 | 161.9339 | 152.7747 | 141.2129 | 130.3465 | 123.0870 | 121.3797 | 125.6821 | 134.8412 | 146.4030 | 157.2694 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 (71) |
| Water heating gains (Table 5)                                                       | 117.0369 | 115.2118 | 111.4218 | 106.2694 | 102.9242 | 98.2141  | 94.2106  | 99.3402  | 101.1627 | 106.4956 | 112.5174 | 115.2194 (72) |
| Total internal gains                                                                | 347.5338 | 345.7760 | 335.2508 | 318.3653 | 301.4332 | 284.9227 | 274.0674 | 279.1297 | 287.6874 | 304.7534 | 324.3621 | 338.8645 (73) |

| [Jan]       |          |          |          |          |            |          |               |          |               |          |          |               |              |
|-------------|----------|----------|----------|----------|------------|----------|---------------|----------|---------------|----------|----------|---------------|--------------|
|             | Area     |          |          |          | Solar flux |          | g             |          | FF            |          | Access   |               | Gains        |
|             | m2       |          |          |          | Table 6a   |          | Specific data |          | Specific data |          | factor   |               | W            |
|             |          |          |          |          | W/m2       |          | or Table 6b   |          | or Table 6c   |          | Table 6d |               |              |
| Northeast   | 11.5920  |          |          |          | 11.2829    |          | 0.3000        |          | 0.8000        |          | 0.7700   |               | 21.7533 (75) |
| Solar gains | 21.7533  | 44.2795  | 79.7775  | 131.0176 | 176.1134   | 187.7555 | 175.6414      | 140.0234 | 97.2102       | 54.1130  | 27.3713  | 17.7648 (83)  |              |
| Total gains | 369.2871 | 390.0555 | 415.0283 | 449.3829 | 477.5466   | 472.6782 | 449.7088      | 419.1530 | 384.8976      | 358.8664 | 351.7334 | 356.6294 (84) |              |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 50.2458 | 50.4647 | 50.6854 | 51.8190 | 52.0518 | 53.2480 | 53.2480 | 53.4938 | 52.7630                   | 52.0518 | 51.5882 | 51.1328      |
| alpha                                                                       | 4.3497  | 4.3643  | 4.3790  | 4.4546  | 4.4701  | 4.5499  | 4.5499  | 4.5663  | 4.5175                    | 4.4701  | 4.4392  | 4.4089       |
| util living area                                                            | 0.9236  | 0.9002  | 0.8459  | 0.7268  | 0.5651  | 0.3967  | 0.2886  | 0.3218  | 0.5198                    | 0.7597  | 0.8837  | 0.9305 (86)  |
| MIT                                                                         | 20.2755 | 20.3984 | 20.6040 | 20.8354 | 20.9539 | 20.9929 | 20.9987 | 20.9979 | 20.9764                   | 20.8318 | 20.5462 | 20.2596 (87) |
| Th 2                                                                        | 20.4726 | 20.4748 | 20.4770 | 20.4879 | 20.4901 | 20.5010 | 20.5010 | 20.5032 | 20.4966                   | 20.4901 | 20.4857 | 20.4813 (88) |
| util rest of house                                                          | 0.9161  | 0.8908  | 0.8320  | 0.7058  | 0.5381  | 0.3667  | 0.2561  | 0.2875  | 0.4852                    | 0.7362  | 0.8716  | 0.9236 (89)  |
| MIT 2                                                                       | 19.4917 | 19.6678 | 19.9583 | 20.2829 | 20.4374 | 20.4940 | 20.5000 | 20.5015 | 20.4723                   | 20.2845 | 19.8882 | 19.4760 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4967 (91)  |
| MIT                                                                         | 19.8811 | 20.0307 | 20.2791 | 20.5574 | 20.6940 | 20.7418 | 20.7477 | 20.7480 | 20.7227                   | 20.5564 | 20.2151 | 19.8652 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.8811 | 20.0307 | 20.2791 | 20.5574 | 20.6940 | 20.7418 | 20.7477 | 20.7480 | 20.7227                   | 20.5564 | 20.2151 | 19.8652 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.9068   | 0.8822   | 0.8265   | 0.7087   | 0.5490   | 0.3812   | 0.2722   | 0.3044   | 0.5009   | 0.7393       | 0.8648   | 0.9145 (94)   |
| Useful gains         | 334.8635 | 344.0898 | 343.0154 | 318.4903 | 262.1668 | 180.1854 | 122.4196 | 127.6001 | 192.7970 | 265.3228     | 304.1690 | 326.1370 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 488.3162 | 472.1445 | 428.0958 | 354.2545 | 272.0953 | 181.6338 | 122.6614 | 127.9955 | 197.6562 | 301.2097     | 400.3360 | 482.4366 (97) |
| Month fracti         | 1.0000   | 1.0000   |          | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 114.1688 | 86.0528  | 63.2998  | 25.7502  | 7.3868   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 26.6998      | 69.2402  | 116.2869 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 508.8853 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 8.9766 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 508.8853  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 534.3296  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1893.9521 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1988.6497 | (310a) |
| Electricity used for heat distribution                                                  | 25.2298   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 90.7749   | (330a) |
| Total electricity for the above, kWh/year                                               | 90.7749   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 259.0392  | (332)  |
| Total delivered energy for all uses                                                     | 2872.7934 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2655.7677          | 0.2160                        | 573.6458 (367)           |
| Electrical energy for heat distribution                                                    | 25.2298            | 0.5190                        | 13.0943 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 586.7401 (373)           |
| Space and water heating                                                                    |                    |                               | 586.7401 (376)           |
| Pumps and fans                                                                             | 90.7749            | 0.5190                        | 47.1122 (378)            |
| Energy for lighting                                                                        | 259.0392           | 0.5190                        | 134.4413 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 768.2936 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 13.5500 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 13.5500 | ZC1 |
| Total Floor Area                                                                | TFA | 56.6900 |     |
| Assumed number of occupants                                                     | N   | 1.8867  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1982 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8979  | ZC3 |
| Total CO2 emissions                                                             |     | 33.6460 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 33.6460 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.6900 (1b)              | x 2.5000 (2b)                   | = 141.7250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 141.7250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Air changes per hour                                                      |                 |                      |                             |                 |                         |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1411 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3911 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3031 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3865 | 0.3789 | 0.3713 | 0.3334 | 0.3259 | 0.2880 | 0.2880 | 0.2804 | 0.3031 | 0.3259 | 0.3410 | 0.3562 (22b) |
| Effective ac    | 0.5747 | 0.5718 | 0.5689 | 0.5556 | 0.5531 | 0.5415 | 0.5415 | 0.5393 | 0.5459 | 0.5531 | 0.5581 | 0.5634 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 11.5900              | 1.3258           | 15.3655      |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 18.0683     | 11.5920        | 6.4763               | 0.1800           | 1.1657       |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 18.0663              |                  |              |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  |              | 16.5313           |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |                      |                  |              |                   |               | 0.9033 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 17.4346       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 26.8774     | 26.7418        | 26.6088              | 25.9844          | 25.8676      | 25.3237           | 25.3237       | 25.2230       | 25.5332 | 25.8676 | 26.1039 | 26.3510 | (38) |
| Heat transfer coeff                                                 | 44.3120     | 44.1764        | 44.0434              | 43.4190          | 43.3021      | 42.7583           | 42.7583       | 42.6576       | 42.9678 | 43.3021 | 43.5385 | 43.7856 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |               |         |         |         | 43.4184 | (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.7817      | 0.7793         | 0.7769               | 0.7659           | 0.7638       | 0.7542            | 0.7542        | 0.7525        | 0.7579  | 0.7638  | 0.7680  | 0.7724  | (40) |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |               |         |         |         | 0.7659  | (40) |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.8867 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 79.0086 (43)   |
| Daily hot water use                                         | 86.9094  | 83.7491  | 80.5887  | 77.4284  | 74.2680 | 71.1077 | 71.1077 | 74.2680 | 77.4284 | 80.5887            | 83.7491  | 86.9094 (44)   |
| Energy conte                                                | 128.8842 | 112.7229 | 116.3199 | 101.4105 | 97.3058 | 83.9675 | 77.8083 | 89.2861 | 90.3525 | 105.2971           | 114.9400 | 124.8174 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1243.1123 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.3326  | 16.9084  | 17.4480  | 15.2116  | 14.5959 | 12.5951 | 11.6712 | 13.3929 | 13.5529 | 15.7946            | 17.2410  | 18.7226 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810                      | 135.4443    | 151.8920 | 160.0319 | 171.4123 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810                      | 135.4443    | 151.8920 | 160.0319 | 171.4123 (64)  |
|                                                                 | 80.1299  | 71.1489  | 75.9523  | 69.7925  | 69.6301  | 63.9927  | 63.1472  | 66.9636                       | 66.1157     | 72.2872  | 74.2910  | 78.7777 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1791.7297 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.7395  | 13.0915  | 10.6467  | 8.0602   | 6.0251   | 5.0867   | 5.4963   | 7.1443   | 9.5891   | 12.1756  | 14.2107  | 15.1491  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 164.5289 | 166.2362 | 161.9339 | 152.7747 | 141.2129 | 130.3465 | 123.0870 | 121.3797 | 125.6821 | 134.8412 | 146.4030 | 157.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | (71) |
| Water heating gains (Table 5)                                                       | 107.7015 | 105.8764 | 102.0864 | 96.9340  | 93.5889  | 88.8787  | 84.8752  | 90.0048  | 91.8273  | 97.1602  | 103.1820 | 105.8840 | (72) |
| Total internal gains                                                                | 341.2700 | 339.5042 | 328.9671 | 312.0691 | 295.1271 | 278.6120 | 267.7587 | 272.8290 | 281.3986 | 298.4771 | 318.0958 | 332.6027 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W   |          |      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|--------------|----------|------|
| -----       |          |          |          |            |                                |                                   |                                    | -----    |          |                              | -----        |          |      |
| Northeast   |          |          |          | 11.5920    | 11.2829                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 39.9717 (75) |          |      |
| -----       |          |          |          |            |                                |                                   |                                    | -----    |          |                              | -----        |          |      |
| Solar gains | 39.9717  | 81.3635  | 146.5912 | 240.7449   | 323.6084                       | 345.0008                          | 322.7411                           | 257.2930 | 178.6237 | 99.4327                      | 50.2947      | 32.6429  | (83) |
| Total gains | 381.2417 | 420.8677 | 475.5583 | 552.8140   | 618.7354                       | 623.6128                          | 590.4999                           | 530.1220 | 460.0223 | 397.9098                     | 368.3905     | 365.2456 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 88.8429 | 89.1157 | 89.3847 | 90.6702 | 90.9148 | 92.0712 | 92.0712 | 92.2885 | 91.6223                   | 90.9148 | 90.4213 | 89.9110 |              |
| alpha                                                                       | 6.9229  | 6.9410  | 6.9590  | 7.0447  | 7.0610  | 7.1381  | 7.1381  | 7.1526  | 7.1082                    | 7.0610  | 7.0281  | 6.9941  |              |
| util living area                                                            | 0.9951  | 0.9891  | 0.9637  | 0.8523  | 0.6396  | 0.4381  | 0.3185  | 0.3700  | 0.6341                    | 0.9230  | 0.9878  | 0.9962  | (86)         |
| MIT                                                                         | 20.3596 | 20.4760 | 20.6795 | 20.9034 | 20.9875 | 20.9992 | 20.9999 | 20.9998 | 20.9915                   | 20.8520 | 20.5704 | 20.3387 | (87)         |
| Th 2                                                                        | 20.2693 | 20.2713 | 20.2734 | 20.2830 | 20.2848 | 20.2932 | 20.2932 | 20.2947 | 20.2899                   | 20.2848 | 20.2811 | 20.2773 | (88)         |
| util rest of house                                                          | 0.9936  | 0.9859  | 0.9536  | 0.8216  | 0.5941  | 0.3901  | 0.2674  | 0.3133  | 0.5731                    | 0.8977  | 0.9837  | 0.9951  | (89)         |
| MIT 2                                                                       | 19.4140 | 19.5841 | 19.8747 | 20.1785 | 20.2740 | 20.2927 | 20.2931 | 20.2946 | 20.2839                   | 20.1225 | 19.7295 | 19.3901 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4967  | (91)         |
| MIT                                                                         | 19.8837 | 20.0271 | 20.2745 | 20.5386 | 20.6284 | 20.6437 | 20.6442 | 20.6449 | 20.6354                   | 20.4849 | 20.1472 | 19.8613 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.8837 | 20.0271 | 20.2745 | 20.5386 | 20.6284 | 20.6437 | 20.6442 | 20.6449 | 20.6354                   | 20.4849 | 20.1472 | 19.8613 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |              |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |       |
| Useful gains         | 0.9926   | 0.9847   | 0.9536   | 0.8330   | 0.6162   | 0.4139   | 0.2928   | 0.3415   | 0.6032   | 0.9055   | 0.9827   | 0.9943       | (94)  |
| Ext temp.            | 378.4214 | 414.4111 | 453.5039 | 460.5182 | 381.2574 | 258.1350 | 172.9052 | 181.0234 | 277.4742 | 360.2963 | 362.0227 | 363.1482     | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)  |
| Month fracti         | 690.5439 | 668.2622 | 606.6750 | 505.3355 | 386.6204 | 258.4164 | 172.9243 | 181.0783 | 280.8106 | 428.0366 | 568.0561 | 685.7391     | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a) |
| Space heating        | 232.2192 | 170.5880 | 113.9593 | 32.2685  | 3.9901   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.3988  | 148.3441 | 240.0076     | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 991.7755     | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 17.4947      | (99)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 1060.7224 | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 232.2192 | 170.5880 | 113.9593 | 32.2685  | 3.9901   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.3988  | 148.3441 | 240.0076  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 248.3627 | 182.4470 | 121.8816 | 34.5117  | 4.2675   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 53.9024  | 158.6568 | 256.6926  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810 | 135.4443 | 151.8920 | 160.0319 | 171.4123  | (64)   |
| Efficiency of water heater                                            | 85.5620  | 85.0731  | 83.8820  | 81.5402  | 80.0554  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2220  | 84.6124  | 85.7117   | (216)  |
| (217)m                                                                | 85.5620  | 85.0731  | 83.8820  | 81.5402  | 80.0554  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2220  | 84.6124  | 85.7117   | (217)  |
| Fuel for water heating, kWh/month                                     | 205.0899 | 181.9714 | 194.2191 | 179.6690 | 179.7515 | 161.7285 | 155.8937 | 170.2770 | 169.7297 | 184.7341 | 189.1353 | 199.9870  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2172.1862 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1060.7224 | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 260.3037  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3568.2124 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1060.7224          | 0.2160                        | 229.1160 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2172.1862          | 0.2160                        | 469.1922 (264)           |
| Space and water heating                                                                           |                    |                               | 698.3083 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 260.3037           | 0.5190                        | 135.0976 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 872.3309 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.3180 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3831 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6866 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.3180 * 1.00) + 2.3831 + 0.6866, rounded to 2 d.p. |                    |                               | 15.3900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000266                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.04_1B |                |            |
| Property                           | A_2_14.04_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.54        | TER            | 15.39      |
| Environmental                      | 91 B                                | % DER<TER     | 18.51        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.66                                | DFEE          | 23.20        | TFEE           | 29.82      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 22.19        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 57 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.39 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.54 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)29.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)23.2 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 11.59 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.6900 (1b)              | x 2.5000 (2b)                   | = 141.7250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 141.7250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |                            |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|----------------------------|---------|---------|---------|---------|------|
| Opening Type 1 (Uw = 1.00)                                          |             |                | 11.5900              | 0.9615           | 11.1442      |                   | (27)          |                            |         |         |         |         |      |
| External Wall 1                                                     | 18.0683     | 11.5920        | 6.4763               | 0.1600           | 1.0362       |                   | (29a)         |                            |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 18.0663              |                  |              |                   | (31)          |                            |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 12.1804      |                   | (33)          |                            |         |         |         |         |      |
| Party Floor 1                                                       |             |                | 56.6900              |                  |              |                   | (32d)         |                            |         |         |         |         |      |
| Party Ceilings 1                                                    |             |                | 56.6900              |                  |              |                   | (32b)         |                            |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |               | 100.0000 (35)              |         |         |         |         |      |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   |               | 2.7099 (36)                |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   |               | (33) + (36) = 14.8904 (37) |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |                            |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug                        | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 12.2287     | 12.0928        | 11.9569              | 11.2772          | 11.1413      | 10.4617           | 10.4617       | 10.3258                    | 10.7335 | 11.1413 | 11.4132 | 11.6850 | (38) |
| Heat transfer coeff                                                 | 27.1191     | 26.9832        | 26.8472              | 26.1676          | 26.0317      | 25.3521           | 25.3521       | 25.2162                    | 25.6239 | 26.0317 | 26.3035 | 26.5754 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |                            |         |         |         | 26.1336 | (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug                        | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.4784      | 0.4760         | 0.4736               | 0.4616           | 0.4592       | 0.4472            | 0.4472        | 0.4448                     | 0.4520  | 0.4592  | 0.4640  | 0.4688  | (40) |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |                            |         |         |         | 0.4610  | (40) |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31                         | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |         |          |          | 1.8867 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |         |          |          | 79.0086 (43)                      |
| Daily hot water use                      | 86.9094  | 83.7491  | 80.5887  | 77.4284  | 74.2680 | 71.1077 | 71.1077 | 74.2680 | 77.4284 | 80.5887  | 83.7491  | 86.9094 (44)                      |
| Energy conte                             | 128.8842 | 112.7229 | 116.3199 | 101.4105 | 97.3058 | 83.9675 | 77.8083 | 89.2861 | 90.3525 | 105.2971 | 114.9400 | 124.8174 (45)                     |
| Energy content (annual)                  |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1243.1123 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |         |         |         |         |         |          |          |                                   |
|                                          | 19.3326  | 16.9084  | 17.4480  | 15.2116  | 14.5959 | 12.5951 | 11.6712 | 13.3929 | 13.5529 | 15.7946  | 17.2410  | 18.7226 (46)                      |
| Water storage loss:                      |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                             |          |          |          |          |         |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |                                                        |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|--------------------------------------------------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |               |                                                        |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          |               | 0.0152 (51)                                            |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          |               | 1.0294 (52)                                            |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          |               | 0.6000 (53)                                            |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          |               | 1.0327 (55)                                            |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |                                                        |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144       | 32.0144 (56)                                           |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |                                                        |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                                                        |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (58)  |                                                        |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |                                                        |
|                                                                 | 184.1610 | 162.6503 | 171.5967 | 154.9042 | 152.5826 | 137.4612 | 133.0851 | 144.5629 | 143.8462 | 160.5739 | 168.4337 | 180.0942 (59) |                                                        |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                                                        |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               | Solar input (sum of months) = Sum (63)m = 0.0000 (63)  |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |                                                        |
|                                                                 | 184.1610 | 162.6503 | 171.5967 | 154.9042 | 152.5826 | 137.4612 | 133.0851 | 144.5629 | 143.8462 | 160.5739 | 168.4337 | 180.0942 (64) |                                                        |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               | Total per year (kWh/year) = Sum (64)m = 1893.9521 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |                                                        |
|                                                                 | 87.0754  | 77.4223  | 82.8978  | 76.5140  | 76.5756  | 70.7141  | 70.0927  | 73.9091  | 72.8371  | 79.2327  | 81.0125  | 85.7232 (65)  |                                                        |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.6679  | 13.0279  | 10.5950  | 8.0211   | 5.9959   | 5.0620   | 5.4696   | 7.1096   | 9.5425   | 12.1164  | 14.1416  | 15.0755 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 164.5289 | 166.2362 | 161.9339 | 152.7747 | 141.2129 | 130.3465 | 123.0870 | 121.3797 | 125.6821 | 134.8412 | 146.4030 | 157.2694 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 (71) |
| Water heating gains (Table 5)                                                       | 117.0369 | 115.2118 | 111.4218 | 106.2694 | 102.9242 | 98.2141  | 94.2106  | 99.3402  | 101.1627 | 106.4956 | 112.5174 | 115.2194 (72) |
| Total internal gains                                                                | 347.5338 | 345.7760 | 335.2508 | 318.3653 | 301.4332 | 284.9227 | 274.0674 | 279.1297 | 287.6874 | 304.7534 | 324.3621 | 338.8645 (73) |

| [Jan        |          |          |          | Area     | Solar flux | g             | FF            |               |               | Access   |          |          | Gains        |
|-------------|----------|----------|----------|----------|------------|---------------|---------------|---------------|---------------|----------|----------|----------|--------------|
|             |          |          |          | m2       | Table 6a   | Specific data | Specific data | Specific data | Specific data | factor   |          |          | W            |
|             |          |          |          |          | W/m2       | or Table 6b   | or Table 6b   | or Table 6c   | or Table 6c   | Table 6d |          |          |              |
| Northeast   |          |          |          | 11.5920  | 11.2829    | 0.5000        |               |               | 0.8000        | 0.7700   |          |          | 36.2555 (75) |
| Solar gains | 36.2555  | 73.7991  | 132.9625 | 218.3627 | 293.5223   | 312.9259      | 292.7357      | 233.3723      | 162.0169      | 90.1884  | 45.6188  | 29.6081  | (83)         |
| Total gains | 383.7893 | 419.5751 | 468.2133 | 536.7280 | 594.9555   | 597.8485      | 566.8031      | 512.5020      | 449.7044      | 394.9418 | 369.9809 | 368.4726 | (84)         |

| Temperature during heating periods in the living area from Table 9, Th1 (C)   |         |         |         |         |         |         |         |         |                                       |         |         | 21.0000 (85) |
|-------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, n <sub>l,m</sub> (see Table 9a) |         |         |         |         |         |         |         |         |                                       |         |         |              |
|                                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                                   | Oct     | Nov     | Dec          |
| tau                                                                           | 58.0669 | 58.3594 | 58.6549 | 60.1783 | 60.4925 | 62.1141 | 62.1141 | 62.4489 | 61.4551                               | 60.4925 | 59.8673 | 59.2549      |
| alpha                                                                         | 4.8711  | 4.8906  | 4.9103  | 5.0119  | 5.0328  | 5.1409  | 5.1409  | 5.1633  | 5.0970                                | 5.0328  | 4.9912  | 4.9503       |
| util living area                                                              | 0.8904  | 0.8443  | 0.7462  | 0.5720  | 0.4043  | 0.2712  | 0.1968  | 0.2262  | 0.3911                                | 0.6496  | 0.8281  | 0.9008 (86)  |
| MIT                                                                           | 20.5435 | 20.6704 | 20.8357 | 20.9602 | 20.9935 | 20.9994 | 20.9999 | 20.9998 | 20.9962                               | 20.9412 | 20.7551 | 20.5275 (87) |
| Th 2                                                                          | 20.5407 | 20.5429 | 20.5451 | 20.5562 | 20.5584 | 20.5695 | 20.5695 | 20.5717 | 20.5650                               | 20.5584 | 20.5540 | 20.5495 (88) |
| util rest of house                                                            | 0.8814  | 0.8327  | 0.7303  | 0.5533  | 0.3856  | 0.2530  | 0.1775  | 0.2052  | 0.3669                                | 0.6270  | 0.8140  | 0.8925 (89)  |
| MIT 2                                                                         | 19.9260 | 20.1050 | 20.3334 | 20.5075 | 20.5511 | 20.5689 | 20.5694 | 20.5715 | 20.5611                               | 20.4879 | 20.2348 | 19.9112 (90) |
| Living area fraction                                                          |         |         |         |         |         |         |         |         | f <sub>LA</sub> = Living area / (4) = |         |         | 0.4967 (91)  |
| MIT                                                                           | 20.2327 | 20.3859 | 20.5829 | 20.7324 | 20.7709 | 20.7827 | 20.7832 | 20.7843 | 20.7772                               | 20.7131 | 20.4933 | 20.2174 (92) |
| Temperature adjustment                                                        |         |         |         |         |         |         |         |         |                                       |         |         | 0.0000       |
| adjusted MIT                                                                  | 20.2327 | 20.3859 | 20.5829 | 20.7324 | 20.7709 | 20.7827 | 20.7832 | 20.7843 | 20.7772                               | 20.7131 | 20.4933 | 20.2174 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8748   | 0.8285   | 0.7317   | 0.5608   | 0.3946   | 0.2620   | 0.1871   | 0.2157   | 0.3787   | 0.6350       | 0.8120   | 0.8859 (94)   |
| Useful gains         | 335.7569 | 347.6313 | 342.5794 | 300.9941 | 234.7643 | 156.6264 | 106.0384 | 110.5232 | 170.3247 | 250.7815     | 300.4372 | 326.4121 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |              |          |               |
|                      | 432.0810 | 417.8577 | 378.0869 | 309.6254 | 236.1300 | 156.7450 | 106.0540 | 110.5548 | 171.0963 | 263.2604     | 352.2899 | 425.6680 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |              |          |               |
|                      | 71.6651  | 47.1922  | 26.4176  | 6.2145   | 1.0161   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 9.2843       | 37.3339  | 73.8464 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 272.9702 (99) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 4.8151 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 272.9702  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 286.6187  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1893.9521 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1988.6497 | (310a) |
| Electricity used for heat distribution                                                  | 22.7527   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 90.7749   | (330a) |
| Total electricity for the above, kWh/year                                               | 90.7749   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 259.0392  | (332)  |
| Total delivered energy for all uses                                                     | 2625.0824 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2395.0194          | 0.2160                        | 517.3242 (367)           |
| Electrical energy for heat distribution                                                    | 22.7527            | 0.5190                        | 11.8086 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 529.1328 (373)           |
| Space and water heating                                                                    |                    |                               | 529.1328 (376)           |
| Pumps and fans                                                                             | 90.7749            | 0.5190                        | 47.1122 (378)            |
| Energy for lighting                                                                        | 259.0392           | 0.5190                        | 134.4413 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 710.6863 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.5400 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 12.5400 | ZC1 |
| Total Floor Area                                                                | TFA | 56.6900 |     |
| Assumed number of occupants                                                     | N   | 1.8867  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1982 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8979  | ZC3 |
| Total CO2 emissions                                                             |     | 32.6360 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 32.6360 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.6900 (1b)              | x 2.5000 (2b)                   | = 141.7250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 141.7250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Air changes per hour                                                      |                 |                      |                             |                 |                         |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1411 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3911 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3031 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3865 | 0.3789 | 0.3713 | 0.3334 | 0.3259 | 0.2880 | 0.2880 | 0.2804 | 0.3031 | 0.3259 | 0.3410 | 0.3562 (22b) |
| Effective ac    | 0.5747 | 0.5718 | 0.5689 | 0.5556 | 0.5531 | 0.5415 | 0.5415 | 0.5393 | 0.5459 | 0.5531 | 0.5581 | 0.5634 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 11.5900                   | 1.3258                        | 15.3655      |                                | (27)          |
| External Wall 1                                                     | 18.0683                 | 11.5920                    | 6.4763                    | 0.1800                        | 1.1657       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 18.0663                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 16.5313      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 0.9033 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 17.4346 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 26.8774                 | 26.7418                    | 26.6088                   | 25.9844                       | 25.8676      | 25.3237                        | 25.3237       |
| Heat transfer coeff                                                 | 44.3120                 | 44.1764                    | 44.0434                   | 43.4190                       | 43.3021      | 42.7583                        | 42.7583       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 42.6576                        | 42.9678       |
|                                                                     | 43.3021                 | 43.5385                    | 43.7856                   | 43.4184                       | 43.3929      | 43.3525                        | 43.3325       |
| HLP                                                                 | 0.7817                  | 0.7793                     | 0.7769                    | 0.7659                        | 0.7638       | 0.7542                         | 0.7542        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.7525                         | 0.7579        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.8867 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 79.0086 (43)   |
| Daily hot water use                                         | 86.9094  | 83.7491  | 80.5887  | 77.4284  | 74.2680 | 71.1077 | 71.1077 | 74.2680 | 77.4284 | 80.5887            | 83.7491  | 86.9094 (44)   |
| Energy conte                                                | 128.8842 | 112.7229 | 116.3199 | 101.4105 | 97.3058 | 83.9675 | 77.8083 | 89.2861 | 90.3525 | 105.2971           | 114.9400 | 124.8174 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1243.1123 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.3326  | 16.9084  | 17.4480  | 15.2116  | 14.5959 | 12.5951 | 11.6712 | 13.3929 | 13.5529 | 15.7946            | 17.2410  | 18.7226 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810 | 135.4443 | 151.8920 | 160.0319 | 171.4123 (62) |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810 | 135.4443 | 151.8920 | 160.0319 | 171.4123 (64) |
| Heat gains from water heating, kWh/month                        | 80.1299  | 71.1489  | 75.9523  | 69.7925  | 69.6301  | 63.9927  | 63.1472  | 66.9636  | 66.1157  | 72.2872  | 74.2910  | 78.7777 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | 94.3338  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.7395  | 13.0915  | 10.6467  | 8.0602   | 6.0251   | 5.0867   | 5.4963   | 7.1443   | 9.5891   | 12.1756  | 14.2107  | 15.1491  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 164.5289 | 166.2362 | 161.9339 | 152.7747 | 141.2129 | 130.3465 | 123.0870 | 121.3797 | 125.6821 | 134.8412 | 146.4030 | 157.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | 32.4334  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | -75.4671 | (71) |
| Water heating gains (Table 5)                                                       | 107.7015 | 105.8764 | 102.0864 | 96.9340  | 93.5889  | 88.8787  | 84.8752  | 90.0048  | 91.8273  | 97.1602  | 103.1820 | 105.8840 | (72) |
| Total internal gains                                                                | 341.2700 | 339.5042 | 328.9671 | 312.0691 | 295.1271 | 278.6120 | 267.7587 | 272.8290 | 281.3986 | 298.4771 | 318.0958 | 332.6027 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W   |          |      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|--------------|----------|------|
| -----       |          |          |          |            |                                |                                   |                                    | -----    |          |                              | -----        |          |      |
| Northeast   |          |          |          | 11.5920    | 11.2829                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 39.9717 (75) |          |      |
| -----       |          |          |          |            |                                |                                   |                                    | -----    |          |                              | -----        |          |      |
| Solar gains | 39.9717  | 81.3635  | 146.5912 | 240.7449   | 323.6084                       | 345.0008                          | 322.7411                           | 257.2930 | 178.6237 | 99.4327                      | 50.2947      | 32.6429  | (83) |
| Total gains | 381.2417 | 420.8677 | 475.5583 | 552.8140   | 618.7354                       | 623.6128                          | 590.4999                           | 530.1220 | 460.0223 | 397.9098                     | 368.3905     | 365.2456 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 88.8429 | 89.1157 | 89.3847 | 90.6702 | 90.9148 | 92.0712 | 92.0712 | 92.2885 | 91.6223 | 90.9148 | 90.4213 | 89.9110 |              |
| alpha                                                                       | 6.9229  | 6.9410  | 6.9590  | 7.0447  | 7.0610  | 7.1381  | 7.1381  | 7.1526  | 7.1082  | 7.0610  | 7.0281  | 6.9941  |              |
| util living area                                                            | 0.9951  | 0.9891  | 0.9637  | 0.8523  | 0.6396  | 0.4381  | 0.3185  | 0.3700  | 0.6341  | 0.9230  | 0.9878  | 0.9962  | (86)         |
| MIT                                                                         | 20.3596 | 20.4760 | 20.6795 | 20.9034 | 20.9875 | 20.9992 | 20.9999 | 20.9998 | 20.9915 | 20.8520 | 20.5704 | 20.3387 | (87)         |
| Th 2                                                                        | 20.2693 | 20.2713 | 20.2734 | 20.2830 | 20.2848 | 20.2932 | 20.2932 | 20.2947 | 20.2899 | 20.2848 | 20.2811 | 20.2773 | (88)         |
| util rest of house                                                          | 0.9936  | 0.9859  | 0.9536  | 0.8216  | 0.5941  | 0.3901  | 0.2674  | 0.3133  | 0.5731  | 0.8977  | 0.9837  | 0.9951  | (89)         |
| MIT 2                                                                       | 19.4140 | 19.5841 | 19.8747 | 20.1785 | 20.2740 | 20.2927 | 20.2931 | 20.2946 | 20.2839 | 20.1225 | 19.7295 | 19.3901 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.8837 | 20.0271 | 20.2745 | 20.5386 | 20.6284 | 20.6437 | 20.6442 | 20.6449 | 20.6354 | 20.4849 | 20.1472 | 19.8613 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.8837 | 20.0271 | 20.2745 | 20.5386 | 20.6284 | 20.6437 | 20.6442 | 20.6449 | 20.6354 | 20.4849 | 20.1472 | 19.8613 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |       |
| Useful gains         | 0.9926   | 0.9847   | 0.9536   | 0.8330   | 0.6162   | 0.4139   | 0.2928   | 0.3415   | 0.6032   | 0.9055   | 0.9827   | 0.9943   | (94)  |
| Ext temp.            | 378.4214 | 414.4111 | 453.5039 | 460.5182 | 381.2574 | 258.1350 | 172.9052 | 181.0234 | 277.4742 | 360.2963 | 362.0227 | 363.1482 | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000   | (96)  |
| Month fracti         | 690.5439 | 668.2622 | 606.6750 | 505.3355 | 386.6204 | 258.4164 | 172.9243 | 181.0783 | 280.8106 | 428.0366 | 568.0561 | 685.7391 | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | (97a) |
| Space heating        | 232.2192 | 170.5880 | 113.9593 | 32.2685  | 3.9901   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.3988  | 148.3441 | 240.0076 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 991.7755 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 17.4947  | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1060.7224 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 232.2192 | 170.5880 | 113.9593 | 32.2685  | 3.9901   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.3988  | 148.3441 | 240.0076  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 248.3627 | 182.4470 | 121.8816 | 34.5117  | 4.2675   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 53.9024  | 158.6568 | 256.6926  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Water heating requirement                                             | 175.4791 | 154.8086 | 162.9148 | 146.5024 | 143.9007 | 129.0594 | 124.4032 | 135.8810 | 135.4443 | 151.8920 | 160.0319 | 171.4123  | (64)            |
| Efficiency of water heater                                            | 85.5620  | 85.0731  | 83.8820  | 81.5402  | 80.0554  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2220  | 84.6124  | 85.7117   | (216)           |
| (217)m                                                                | 85.5620  | 85.0731  | 83.8820  | 81.5402  | 80.0554  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2220  | 84.6124  | 85.7117   | (217)           |
| Fuel for water heating, kWh/month                                     | 205.0899 | 181.9714 | 194.2191 | 179.6690 | 179.7515 | 161.7285 | 155.8937 | 170.2770 | 169.7297 | 184.7341 | 189.1353 | 199.9870  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2172.1862 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1060.7224 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 260.3037  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3568.2124 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1060.7224          | 0.2160                        | 229.1160 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2172.1862          | 0.2160                        | 469.1922 (264)           |
| Space and water heating                                                                           |                    |                               | 698.3083 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 260.3037           | 0.5190                        | 135.0976 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 872.3309 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.3180 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3831 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6866 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.3180 * 1.00) + 2.3831 + 0.6866, rounded to 2 d.p. |                    |                               | 15.3900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000294                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.05_2B |                |            |
| Property                           | A_2_14.05_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 12.90        | TER            | 14.11      |
| Environmental                      | 89 B                                | % DER<TER     | 8.60         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.06                                | DFEE          | 35.66        | TFEE           | 37.92      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 5.96         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 96 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.11 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.90 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)37.9 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)35.7 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 16.68 m <sup>2</sup> , No overhang |
| Windows facing North West: | 7.62 m <sup>2</sup> , No overhang  |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 96.4800 (1b)              | x 2.5000 (2b)                   | = 241.2000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 96.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 241.2000 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main                         | secondary | other   |        |        | total          | m3 per hour          |               |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|------------------------------|-----------|---------|--------|--------|----------------|----------------------|---------------|
|                                                                                              |        |        |        |        | heating                      |           | heating |        |        |                |                      |               |
| Number of chimneys                                                                           |        |        |        |        | 0                            | +         | 0       | +      | 0      | =              | 0 * 40 =             | 0.0000 (6a)   |
| Number of open flues                                                                         |        |        |        |        | 0                            | +         | 0       | +      | 0      | =              | 0 * 20 =             | 0.0000 (6b)   |
| Number of intermittent fans                                                                  |        |        |        |        |                              |           |         |        |        |                | 0 * 10 =             | 0.0000 (7a)   |
| Number of passive vents                                                                      |        |        |        |        |                              |           |         |        |        |                | 0 * 10 =             | 0.0000 (7b)   |
| Number of flueless gas fires                                                                 |        |        |        |        |                              |           |         |        |        |                | 0 * 40 =             | 0.0000 (7c)   |
|                                                                                              |        |        |        |        |                              |           |         |        |        |                | Air changes per hour |               |
| Infiltration due to chimneys, flues and fans                                                 |        |        |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |           |         |        |        | 0.0000 / (5) = |                      | 0.0000 (8)    |
| Pressure test                                                                                |        |        |        |        |                              |           |         |        |        | Yes            |                      |               |
| Measured/design AP50                                                                         |        |        |        |        |                              |           |         |        |        | 3.0000         |                      |               |
| Infiltration rate                                                                            |        |        |        |        |                              |           |         |        |        | 0.1500         |                      | (18)          |
| Number of sides sheltered                                                                    |        |        |        |        |                              |           |         |        |        | 2              |                      | (19)          |
| Shelter factor                                                                               |        |        |        |        | (20) = 1 - [0.075 x (19)] =  |           |         |        |        | 0.8500         |                      | (20)          |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        | (21) = (18) x (20) =         |           |         |        |        | 0.1275         |                      | (21)          |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May                          | Jun       | Jul     | Aug    | Sep    | Oct            | Nov                  | Dec           |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000                       | 3.8000    | 3.8000  | 3.7000 | 4.0000 | 4.3000         | 4.5000               | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750                       | 0.9500    | 0.9500  | 0.9250 | 1.0000 | 1.0750         | 1.1250               | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371                       | 0.1211    | 0.1211  | 0.1179 | 0.1275 | 0.1371         | 0.1434               | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |                              |           |         |        |        |                |                      |               |
| If mechanical ventilation:                                                                   |        |        |        |        |                              |           |         |        |        |                |                      | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |                              |           |         |        |        |                |                      | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503                       | 0.2344    | 0.2344  | 0.2312 | 0.2408 | 0.2503         | 0.2567               | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|---------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 24.3000       | 1.3258           | 32.2159      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 49.3998       | 24.3000        | 25.0998       | 0.1600           | 4.0160       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 49.3998       |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...       | (30) + (32) =    | 36.2319      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 96.4800       |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 96.4800       |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |               |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |               |                  |              |                   | 7.4100 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |               |                  |              |                   | 43.6418 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |               |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar           | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 21.9536       | 21.6999        | 21.4461       | 20.1776          | 19.9239      | 18.6553           | 18.6553       | 18.4016 | 19.1627 | 19.9239 | 20.4313 | 20.9387 (38) |
| Heat transfer coeff                                                 | 65.5954       | 65.3417        | 65.0880       | 63.8194          | 63.5657      | 62.2972           | 62.2972       | 62.0434 | 62.8046 | 63.5657 | 64.0731 | 64.5806 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |               |                  |              |                   |               |         |         |         |         | 63.7560 (39) |
|                                                                     | Jan           | Feb            | Mar           | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.6799        | 0.6773         | 0.6746        | 0.6615           | 0.6588       | 0.6457            | 0.6457        | 0.6431  | 0.6510  | 0.6588  | 0.6641  | 0.6694 (40)  |
| HLP (average)                                                       |               |                |               |                  |              |                   |               |         |         |         |         | 0.6608 (40)  |
| Days in month                                                       | 31            | 28             | 31            | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |              |             |             |             |             |             |             |              |              |                                   |
|------------------------------------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|-----------------------------------|
| Assumed occupancy                        |              |              |              |             |             |             |             |             |             |              |              | 2.7045 (42)                       |
| Average daily hot water use (litres/day) |              |              |              |             |             |             |             |             |             |              |              | 98.4310 (43)                      |
| Daily hot water use                      | Jan 108.2741 | Feb 104.3369 | Mar 100.3996 | Apr 96.4624 | May 92.5251 | Jun 88.5879 | Jul 88.5879 | Aug 92.5251 | Sep 96.4624 | Oct 100.3996 | Nov 104.3369 | Dec 108.2741 (44)                 |
| Energy conte                             | 160.5674     | 140.4332     | 144.9145     | 126.3400    | 121.2262    | 104.6090    | 96.9356     | 111.2351    | 112.5636    | 131.1820     | 143.1954     | 155.5009 (45)                     |
| Energy content (annual)                  |              |              |              |             |             |             |             |             |             |              |              | Total = Sum(45)m = 1548.7030 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 24.0851      | 21.0650      | 21.7372      | 18.9510     | 18.1839     | 15.6914     | 14.5403     | 16.6853     | 16.8845     | 19.6773      | 21.4793      | 23.3251 (46)                      |
| Water storage loss:                      |              |              |              |             |             |             |             |             |             |              |              | 110.0000 (47)                     |
| Store volume                             |              |              |              |             |             |             |             |             |             |              |              |                                   |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)    |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 215.8442 | 190.3607 | 200.1913 | 179.8337 | 176.5030 | 158.1027 | 152.2124 | 166.5119 | 166.0572 | 186.4588 | 196.6891 | 210.7777 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 | 215.8442 | 190.3607 | 200.1913 | 179.8337 | 176.5030 | 158.1027 | 152.2124 | 166.5119 | 166.0572 | 186.4588 | 196.6891 | 210.7777 (64)  |
| Total per year (kWh/year) = Sum (64)m =                         |          |          |          |          |          |          |          |          |          |          |          | 2199.5428 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 97.6101  | 86.6360  | 92.4055  | 84.8030  | 84.5292  | 77.5774  | 76.4525  | 81.2071  | 80.2223  | 87.8395  | 90.4074  | 95.9255 (65)   |

| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 22.3330   | 19.8360   | 16.1317   | 12.2127   | 9.1292    | 7.7072    | 8.3279    | 10.8250   | 14.5292   | 18.4482   | 21.5318   | 22.9537 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 250.5084  | 253.1079  | 246.5572  | 232.6117  | 215.0080  | 198.4629  | 187.4098  | 184.8103  | 191.3610  | 205.3065  | 222.9103  | 239.4553 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 (71) |
| Water heating gains (Table 5)                                                       | 131.1964  | 128.9226  | 124.2010  | 117.7819  | 113.6145  | 107.7465  | 102.7588  | 109.1493  | 111.4199  | 118.0638  | 125.5659  | 128.9321 (72)  |
| Total internal gains                                                                | 467.6047  | 465.4334  | 450.4569  | 426.1733  | 401.3185  | 377.4836  | 362.0635  | 368.3516  | 380.8771  | 405.3854  | 433.5748  | 454.9081 (73)  |

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 16.6800    | 11.2829                        | 0.3000                            | 0.8000                             | 0.7700                       | 31.3013 (75) |
| Northwest | 7.6200     | 11.2829                        | 0.3000                            | 0.8000                             | 0.7700                       | 14.2995 (81) |

|                        |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| MIT                    | 19.6752 | 19.8493 | 20.1654 | 20.5725 | 20.8447 | 20.9649 | 20.9912 | 20.9858 | 20.8963 | 20.5388 | 20.0556 | 19.6518 (87) |
| Th 2                   | 20.3586 | 20.3610 | 20.3633 | 20.3750 | 20.3773 | 20.3890 | 20.3890 | 20.3914 | 20.3844 | 20.3773 | 20.3726 | 20.3680 (88) |
| util rest of house     |         |         |         |         |         |         |         |         |         |         |         |              |
|                        | 0.9635  | 0.9480  | 0.9086  | 0.8087  | 0.6447  | 0.4542  | 0.3205  | 0.3689  | 0.6182  | 0.8570  | 0.9432  | 0.9680 (89)  |
| MIT 2                  | 18.5479 | 18.8009 | 19.2557 | 19.8344 | 20.1981 | 20.3548 | 20.3824 | 20.3801 | 20.2753 | 19.7992 | 19.1094 | 18.5205 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                    | 18.9286 | 19.1549 | 19.5629 | 20.0836 | 20.4165 | 20.5608 | 20.5880 | 20.5846 | 20.4850 | 20.0490 | 19.4289 | 18.9025 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT           | 18.9286 | 19.1549 | 19.5629 | 20.0836 | 20.4165 | 20.5608 | 20.5880 | 20.5846 | 20.4850 | 20.0490 | 19.4289 | 18.9025 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9523   | 0.9350   | 0.8941   | 0.7988   | 0.6468   | 0.4664   | 0.3367   | 0.3859   | 0.6256   | 0.8458       | 0.9304   | 0.9576 (94)    |
| Useful gains         | 488.7126 | 521.9752 | 552.2723 | 559.8247 | 498.3718 | 359.6039 | 245.8943 | 255.4030 | 365.7801 | 438.8209     | 456.7905 | 471.2914 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 959.5676 | 931.4397 | 850.2375 | 713.7334 | 554.0689 | 371.3430 | 248.4395 | 259.6276 | 401.0063 | 600.6298     | 789.9501 | 949.4985 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 350.3161 | 275.1601 | 221.6861 | 110.8143 | 41.4386  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 120.3858     | 239.8749 | 355.7860 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1715.4621 (99) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 17.7805 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1715.4621 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1801.2352 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2199.5428 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2309.5199 (310a) |
| Electricity used for heat distribution                                                  | 41.1076 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 161.8452 (330a)  |
| Total electricity for the above, kWh/year                                               | 161.8452 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 394.4078 (332)   |
| Total delivered energy for all uses                                                     | 4667.0081 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 4327.1106          | 0.2160                        | 934.6559 (367)           |
| Electrical energy for heat distribution                                                    | 41.1076            | 0.5190                        | 21.3348 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 955.9907 (373)           |
| Space and water heating                                                                    |                    |                               | 955.9907 (376)           |
| Pumps and fans                                                                             | 161.8452           | 0.5190                        | 83.9977 (378)            |
| Energy for lighting                                                                        | 394.4078           | 0.5190                        | 204.6977 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1244.6860 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.9000 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.9000 ZC1 |
| Total Floor Area                                                                | TFA | 96.4800     |
| Assumed number of occupants                                                     | N   | 2.7045      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 15.3862 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.9062 ZC3  |
| Total CO2 emissions                                                             |     | 30.1924 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 30.1924 ZC8 |



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|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 96.4800 (1b)              | x 2.5000 (2b)                   | = 241.2000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 96.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 241.2000 (5)              |

|                                                      | main<br>heating              |   | secondary<br>heating |   | other |   | total                       | m3 per hour |      |
|------------------------------------------------------|------------------------------|---|----------------------|---|-------|---|-----------------------------|-------------|------|
| Number of chimneys                                   | 0                            | + | 0                    | + | 0     | = | 0 * 40 =                    | 0.0000      | (6a) |
| Number of open flues                                 | 0                            | + | 0                    | + | 0     | = | 0 * 20 =                    | 0.0000      | (6b) |
| Number of intermittent fans                          |                              |   |                      |   |       |   | 3 * 10 =                    | 30.0000     | (7a) |
| Number of passive vents                              |                              |   |                      |   |       |   | 0 * 10 =                    | 0.0000      | (7b) |
| Number of flueless gas fires                         |                              |   |                      |   |       |   | 0 * 40 =                    | 0.0000      | (7c) |
| Air changes per hour                                 |                              |   |                      |   |       |   |                             |             |      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |   |                      |   |       |   | 30.0000 / (5) =             | 0.1244      | (8)  |
| Pressure test                                        |                              |   |                      |   |       |   | Yes                         |             |      |
| Measured/design AP50                                 |                              |   |                      |   |       |   |                             | 5.0000      |      |
| Infiltration rate                                    |                              |   |                      |   |       |   |                             | 0.3744      | (18) |
| Number of sides sheltered                            |                              |   |                      |   |       |   |                             | 2           | (19) |
| Shelter factor                                       |                              |   |                      |   |       |   | (20) = 1 - [0.075 x (19)] = | 0.8500      | (20) |
| Infiltration rate adjusted to include shelter factor |                              |   |                      |   |       |   | (21) = (18) x (20) =        | 0.3182      | (21) |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4057 | 0.3978 | 0.3898 | 0.3500 | 0.3421 | 0.3023 | 0.3023 | 0.2944 | 0.3182 | 0.3421 | 0.3580 | 0.3739 (22b) |
| Effective ac    | 0.5823 | 0.5791 | 0.5760 | 0.5613 | 0.5585 | 0.5457 | 0.5457 | 0.5433 | 0.5506 | 0.5585 | 0.5641 | 0.5699 (25)  |

|                                                                     |         |             |                |                        |                  |              |                   |               |         |         |         |         |      |
|---------------------------------------------------------------------|---------|-------------|----------------|------------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|------|
| Element                                                             |         | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |         |             |                | 24.1200                | 1.3258           | 31.9773      |                   |               | (27)    |         |         |         |      |
| External Wall 1                                                     | 49.3998 | 24.1200     | 25.2798        | 0.1800                 | 4.5504           |              |                   |               | (29a)   |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |         |             | 49.3998        |                        |                  |              |                   |               | (31)    |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |         |             |                | (26) ... (30) + (32) = | 36.5276          |              |                   |               | (33)    |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |         |             |                |                        |                  |              |                   | 250.0000      | (35)    |         |         |         |      |
| Thermal Bridges (User defined value 0.050 * total exposed area)     |         |             |                |                        |                  |              |                   | 2.4700        | (36)    |         |         |         |      |
| Total fabric heat loss                                              |         |             |                |                        |                  |              | (33) + (36) =     | 38.9976       | (37)    |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |             |                |                        |                  |              |                   |               |         |         |         |         |      |
| (38)m                                                               | Jan     | Feb         | Mar            | Apr                    | May              | Jun          | Jul               | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| Heat transfer coeff                                                 | 46.3495 | 46.0951     | 45.8457        | 44.6745                | 44.4553          | 43.4352      | 43.4352           | 43.2463       | 43.8281 | 44.4553 | 44.8986 | 45.3621 | (38) |
|                                                                     | 85.3471 | 85.0927     | 84.8434        | 83.6721                | 83.4530          | 82.4328      | 82.4328           | 82.2439       | 82.8258 | 83.4530 | 83.8963 | 84.3597 | (39) |
| Average = Sum(39)m / 12 =                                           |         |             |                |                        |                  |              |                   |               |         |         |         | 83.6710 | (39) |
|                                                                     | Jan     | Feb         | Mar            | Apr                    | May              | Jun          | Jul               | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.8846  | 0.8820      | 0.8794         | 0.8672                 | 0.8650           | 0.8544       | 0.8544            | 0.8524        | 0.8585  | 0.8650  | 0.8696  | 0.8744  | (40) |
| HLP (average)                                                       |         |             |                |                        |                  |              |                   |               |         |         |         | 0.8672  | (40) |
| Days in month                                                       | 31      | 28          | 31             | 30                     | 31               | 30           | 31                | 31            | 30      | 31      | 30      | 31      | (41) |

|                                                             |          |          |          |          |          |          |         |          |          |          |                    |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|--------------------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |                    | 2.7045 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |                    | 98.4310 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov                | Dec            |
| Daily hot water use                                         |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                                             | 108.2741 | 104.3369 | 100.3996 | 96.4624  | 92.5251  | 88.5879  | 88.5879 | 92.5251  | 96.4624  | 100.3996 | 104.3369           | 108.2741 (44)  |
| Energy conte                                                | 160.5674 | 140.4332 | 144.9145 | 126.3400 | 121.2262 | 104.6090 | 96.9356 | 111.2351 | 112.5636 | 131.1820 | 143.1954           | 155.5009 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          | Total = Sum(45)m = | 1548.7030 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                                             | 24.0851  | 21.0650  | 21.7372  | 18.9510  | 18.1839  | 15.6914  | 14.5403 | 16.6853  | 16.8845  | 19.6773  | 21.4793            | 23.3251 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |                    |                |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |                    | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |                    | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |                    | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |                    | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325  | 22.5798  | 23.3325  | 22.5798            | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |          |         |          |          |          |                    |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 207.1623 | 182.5190 | 191.5094 | 171.4318 | 167.8211 | 149.7009 | 143.5305 | 157.8300                      | 157.6554    | 177.7769 | 188.2872 | 202.0958 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 207.1623 | 182.5190 | 191.5094 | 171.4318 | 167.8211 | 149.7009 | 143.5305 | 157.8300                      | 157.6554    | 177.7769 | 188.2872 | 202.0958 (64)  |
|                                                                 | 90.6646  | 80.3626  | 85.4600  | 78.0815  | 77.5836  | 70.8560  | 69.5070  | 74.2616                       | 73.5009     | 80.8939  | 83.6859  | 88.9800 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 2097.3204 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
| (66)m                                                                               | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232 (66)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 22.3330   | 19.8360   | 16.1317   | 12.2127   | 9.1292    | 7.7072    | 8.3279    | 10.8250   | 14.5292   | 18.4482   | 21.5318   | 22.9537 (67)   |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 250.5084  | 253.1079  | 246.5572  | 232.6117  | 215.0080  | 198.4629  | 187.4098  | 184.8103  | 191.3610  | 205.3065  | 222.9103  | 239.4553 (68)  |
| Pumps, fans                                                                         | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223 (69)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Water heating gains (Table 5)                                                       | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 (71) |
| Total internal gains                                                                | 121.8610  | 119.5872  | 114.8656  | 108.4466  | 104.2791  | 98.4111   | 93.4234   | 99.8140   | 102.0845  | 108.7284  | 116.2305  | 119.5967 (72)  |
|                                                                                     | 461.2693  | 459.0980  | 444.1215  | 419.8379  | 394.9832  | 371.1482  | 355.7281  | 362.0162  | 374.5417  | 399.0501  | 427.2394  | 448.5727 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          |          | 16.5600    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 57.1024 (75) |               |
| Northwest   |          |          |          |          | 7.5600     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 26.0685 (81) |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 83.1709  | 169.2968 | 305.0190 | 500.9288 | 673.3466   | 717.8587                       | 671.5421                          | 535.3612                           | 371.6704                     | 206.8941 | 104.6505     | 67.9215 (83)  |
| Total gains | 544.4402 | 628.3948 | 749.1405 | 920.7667 | 1068.3297  | 1089.0069                      | 1027.2702                         | 897.3774                           | 746.2121                     | 605.9442 | 531.8900     | 516.4942 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
| tau                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| alpha                                                                       | 78.5029 | 78.7376 | 78.9691 | 80.0745 | 80.2848 | 81.2783 | 81.2783 | 81.4650 | 80.8927                   | 80.2848 | 79.8605 | 79.4218      |
| util living area                                                            | 6.2335  | 6.2492  | 6.2646  | 6.3383  | 6.3523  | 6.4186  | 6.4186  | 6.4310  | 6.3928                    | 6.3523  | 6.3240  | 6.2948       |
|                                                                             | 0.9985  | 0.9958  | 0.9820  | 0.9011  | 0.6976  | 0.4821  | 0.3528  | 0.4206  | 0.7280                    | 0.9668  | 0.9962  | 0.9989 (86)  |
| MIT                                                                         | 20.0981 | 20.2384 | 20.4936 | 20.8125 | 20.9684 | 20.9973 | 20.9997 | 20.9991 | 20.9710                   | 20.7104 | 20.3473 | 20.0763 (87) |
| Th 2                                                                        | 20.1806 | 20.1829 | 20.1851 | 20.1954 | 20.1974 | 20.2064 | 20.2064 | 20.2081 | 20.2029                   | 20.1974 | 20.1934 | 20.1893 (88) |
| util rest of house                                                          | 0.9980  | 0.9945  | 0.9762  | 0.8747  | 0.6464  | 0.4234  | 0.2893  | 0.3487  | 0.6582                    | 0.9525  | 0.9947  | 0.9985 (89)  |
| MIT 2                                                                       | 18.9641 | 19.1703 | 19.5406 | 19.9855 | 20.1695 | 20.2048 | 20.2063 | 20.2078 | 20.1814                   | 19.8609 | 19.3379 | 18.9388 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3377 (91)  |
| MIT                                                                         | 19.3470 | 19.5310 | 19.8624 | 20.2647 | 20.4392 | 20.4724 | 20.4742 | 20.4750 | 20.4480                   | 20.1478 | 19.6788 | 19.3229 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.3470 | 19.5310 | 19.8624 | 20.2647 | 20.4392 | 20.4724 | 20.4742 | 20.4750 | 20.4480                   | 20.1478 | 19.6788 | 19.3229 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
| Useful gains         | 0.9973    | 0.9930    | 0.9734    | 0.8772   | 0.6623   | 0.4432   | 0.3108   | 0.3731   | 0.6806   | 0.9514       | 0.9934    | 0.9980 (94)    |
| Ext temp.            | 542.9470  | 624.0242  | 729.1996  | 807.7285 | 707.5209 | 482.5988 | 319.2421 | 334.7704 | 507.8704 | 576.5215     | 528.4034  | 515.4560 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000 (96)    |
| Month fracti         | 1284.2206 | 1244.9895 | 1133.7114 | 950.9107 | 729.3148 | 484.0799 | 319.3639 | 335.1433 | 525.7784 | 796.7886     | 1055.3117 | 1275.7618 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating        | 551.5075  | 417.2887  | 300.9567  | 103.0912 | 16.2146  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.8787     | 379.3740  | 565.6675 (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |              |           | 2497.9791 (98) |
|                      |           |           |           |          |          |          |          |          |          | (98) / (4) = |           | 25.8912 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2671.6354 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 551.5075 | 417.2887 | 300.9567 | 103.0912 | 16.2146  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.8787 | 379.3740 | 565.6675  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 589.8476 | 446.2981 | 321.8789 | 110.2580 | 17.3419  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 175.2714 | 405.7476 | 604.9920  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Water heating requirement                                             | 207.1623 | 182.5190 | 191.5094 | 171.4318 | 167.8211 | 149.7009 | 143.5305 | 157.8300 | 157.6554 | 177.7769 | 188.2872 | 202.0958  | (64)            |
| Efficiency of water heater                                            | 87.3035  | 86.9522  | 86.0149  | 83.5077  | 80.6400  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.5976  | 86.6464  | 87.4147   | (217)           |
| Fuel for water heating, kWh/month                                     | 237.2897 | 209.9072 | 222.6467 | 205.2887 | 208.1115 | 187.5951 | 179.8628 | 197.7819 | 197.5632 | 210.1440 | 217.3052 | 231.1920  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2504.6880 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2671.6354 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 394.4078  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5645.7312 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2671.6354          | 0.2160                        | 577.0732 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2504.6880          | 0.2160                        | 541.0126 (264)           |
| Space and water heating                                                                           |                    |                               | 1118.0859 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 394.4078           | 0.5190                        | 204.6977 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1361.7085 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.5888 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1217 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4035 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.5888 * 1.00) + 2.1217 + 0.4035, rounded to 2 d.p. |                    |                               | 14.1100 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000338                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.05_2B |                |            |
| Property                           | A_2_14.05_2B, A_2_14.05_2B          |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 87 B                                | DER           | 11.34        | TER            | 14.11      |
| Environmental                      | 91 B                                | % DER<TER     | 19.65        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.95                                | DFEE          | 29.42        | TFEE           | 37.92      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 22.41        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 96 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.11 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 11.34 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)37.9 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)29.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 16.68 m <sup>2</sup> , No overhang |
| Windows facing North West: | 7.62 m <sup>2</sup> , No overhang  |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 96.4800 (1b)              | x 2.5000 (2b)                   | = 241.2000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 96.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 241.2000 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    | secondary | other   |        |        | total                        | m3 per hour          |                |            |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|-----------|---------|--------|--------|------------------------------|----------------------|----------------|------------|
|                                                                                              |        |        |        |        | heating |           | heating |        |        |                              |                      |                |            |
| Number of chimneys                                                                           |        |        |        |        | 0       | +         | 0       | +      | 0      | =                            | 0 * 40 =             | 0.0000 (6a)    |            |
| Number of open flues                                                                         |        |        |        |        | 0       | +         | 0       | +      | 0      | =                            | 0 * 20 =             | 0.0000 (6b)    |            |
| Number of intermittent fans                                                                  |        |        |        |        |         |           |         |        |        |                              | 0 * 10 =             | 0.0000 (7a)    |            |
| Number of passive vents                                                                      |        |        |        |        |         |           |         |        |        |                              | 0 * 10 =             | 0.0000 (7b)    |            |
| Number of flueless gas fires                                                                 |        |        |        |        |         |           |         |        |        |                              | 0 * 40 =             | 0.0000 (7c)    |            |
|                                                                                              |        |        |        |        |         |           |         |        |        |                              | Air changes per hour |                |            |
| Infiltration due to chimneys, flues and fans                                                 |        |        |        |        |         |           |         |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test                                                                                |        |        |        |        |         |           |         |        |        |                              | Yes                  |                |            |
| Measured/design AP50                                                                         |        |        |        |        |         |           |         |        |        |                              | 3.0000               |                |            |
| Infiltration rate                                                                            |        |        |        |        |         |           |         |        |        |                              | 0.1500 (18)          |                |            |
| Number of sides sheltered                                                                    |        |        |        |        |         |           |         |        |        |                              | 2 (19)               |                |            |
| Shelter factor                                                                               |        |        |        |        |         |           |         |        |        | (20) = 1 - [0.075 x (19)] =  |                      | 0.8500 (20)    |            |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |           |         |        |        | (21) = (18) x (20) =         |                      | 0.1275 (21)    |            |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul     | Aug    | Sep    | Oct                          | Nov                  | Dec            |            |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000    | 3.8000  | 3.7000 | 4.0000 | 4.3000                       | 4.5000               | 4.7000 (22)    |            |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500    | 0.9500  | 0.9250 | 1.0000 | 1.0750                       | 1.1250               | 1.1750 (22a)   |            |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371  | 0.1211    | 0.1211  | 0.1179 | 0.1275 | 0.1371                       | 0.1434               | 0.1498 (22b)   |            |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |           |         |        |        |                              |                      |                |            |
| If mechanical ventilation:                                                                   |        |        |        |        |         |           |         |        |        |                              |                      | 0.5000 (23a)   |            |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |           |         |        |        |                              |                      | 77.3500 (23c)  |            |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503  | 0.2344    | 0.2344  | 0.2312 | 0.2408 | 0.2503                       | 0.2567               | 0.2631 (25)    |            |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|---------------|----------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |               |                | 24.3000       | 0.9615               | 23.3654      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 49.3998       | 24.3000        | 25.0998       | 0.1600               | 4.0160       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 49.3998       |                      |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                |               | (26)...(30) + (32) = | 27.3814      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 96.4800       |                      |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 96.4800       |                      |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |               |                      |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |               |                      |              |                   | 7.4100 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |               |                      |              |                   | 34.7913 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |               |                      |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 21.9536       | 21.6999        | 21.4461       | 20.1776              | 19.9239      | 18.6553           | 18.6553       | 18.4016 | 19.1627 | 19.9239 | 20.4313 | 20.9387 (38) |
| Heat transfer coeff                                                 | 56.7449       | 56.4912        | 56.2375       | 54.9689              | 54.7152      | 53.4466           | 53.4466       | 53.1929 | 53.9541 | 54.7152 | 55.2226 | 55.7300 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |               |                      |              |                   |               |         |         |         |         | 54.9055 (39) |
|                                                                     | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.5882        | 0.5855         | 0.5829        | 0.5697               | 0.5671       | 0.5540            | 0.5540        | 0.5513  | 0.5592  | 0.5671  | 0.5724  | 0.5776 (40)  |
| HLP (average)                                                       |               |                |               |                      |              |                   |               |         |         |         |         | 0.5691 (40)  |
| Days in month                                                       | 31            | 28             | 31            | 30                   | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |              |             |             |             |             |             |             |              |              |                                   |
|------------------------------------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|-----------------------------------|
| Assumed occupancy                        |              |              |              |             |             |             |             |             |             |              |              | 2.7045 (42)                       |
| Average daily hot water use (litres/day) |              |              |              |             |             |             |             |             |             |              |              | 98.4310 (43)                      |
| Daily hot water use                      | Jan 108.2741 | Feb 104.3369 | Mar 100.3996 | Apr 96.4624 | May 92.5251 | Jun 88.5879 | Jul 88.5879 | Aug 92.5251 | Sep 96.4624 | Oct 100.3996 | Nov 104.3369 | Dec 108.2741 (44)                 |
| Energy conte                             | 160.5674     | 140.4332     | 144.9145     | 126.3400    | 121.2262    | 104.6090    | 96.9356     | 111.2351    | 112.5636    | 131.1820     | 143.1954     | 155.5009 (45)                     |
| Energy content (annual)                  |              |              |              |             |             |             |             |             |             |              |              | Total = Sum(45)m = 1548.7030 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 24.0851      | 21.0650      | 21.7372      | 18.9510     | 18.1839     | 15.6914     | 14.5403     | 16.6853     | 16.8845     | 19.6773      | 21.4793      | 23.3251 (46)                      |
| Water storage loss:                      |              |              |              |             |             |             |             |             |             |              |              | 110.0000 (47)                     |
| Store volume                             |              |              |              |             |             |             |             |             |             |              |              |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 215.8442 | 190.3607 | 200.1913 | 179.8337 | 176.5030 | 158.1027 | 152.2124 | 166.5119                                 | 166.0572 | 186.4588 | 196.6891 | 210.7777 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 215.8442 | 190.3607 | 200.1913 | 179.8337 | 176.5030 | 158.1027 | 152.2124 | 166.5119                                 | 166.0572 | 186.4588 | 196.6891 | 210.7777 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 2199.5428 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 97.6101  | 86.6360  | 92.4055  | 84.8030  | 84.5292  | 77.5774  | 76.4525  | 81.2071                                  | 80.2223  | 87.8395  | 90.4074  | 95.9255 (65)  |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 22.3330   | 19.8360   | 16.1317   | 12.2127   | 9.1292    | 7.7072    | 8.3279    | 10.8250   | 14.5292   | 18.4482   | 21.5318   | 22.9537 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 250.5084  | 253.1079  | 246.5572  | 232.6117  | 215.0080  | 198.4629  | 187.4098  | 184.8103  | 191.3610  | 205.3065  | 222.9103  | 239.4553 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 (71) |
| Water heating gains (Table 5)                                                       | 131.1964  | 128.9226  | 124.2010  | 117.7819  | 113.6145  | 107.7465  | 102.7588  | 109.1493  | 111.4199  | 118.0638  | 125.5659  | 128.9321 (72)  |
| Total internal gains                                                                | 467.6047  | 465.4334  | 450.4569  | 426.1733  | 401.3185  | 377.4836  | 362.0635  | 368.3516  | 380.8771  | 405.3854  | 433.5748  | 454.9081 (73)  |

#### 6. Solar gains

|             |          |            |          |                                |           |                              |          |                                    |          |                              |          |               |
|-------------|----------|------------|----------|--------------------------------|-----------|------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
| [Jan]       |          | Area<br>m2 |          | Solar flux<br>Table 6a<br>W/m2 |           | Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
| Northeast   |          | 16.6800    |          | 11.2829                        |           | 0.5000                       |          | 0.8000                             |          | 0.7700                       |          | 52.1689 (75)  |
| Northwest   |          | 7.6200     |          | 11.2829                        |           | 0.5000                       |          | 0.8000                             |          | 0.7700                       |          | 23.8326 (81)  |
| Solar gains | 76.0014  | 154.7031   | 278.7258 | 457.7479                       | 615.3030  | 655.9781                     | 613.6541 | 489.2121                           | 339.6318 | 189.0595                     | 95.6295  | 62.0666 (83)  |
| Total gains | 543.6061 | 620.1365   | 729.1827 | 883.9212                       | 1016.6215 | 1033.4617                    | 975.7176 | 857.5637                           | 720.5089 | 594.4449                     | 529.2043 | 516.9747 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 47.2289 | 47.4410 | 47.6551 | 48.7548 | 48.9809 | 50.1435 | 50.1435 | 50.3826 | 49.6719 | 48.9809 | 48.5308 | 48.0890      |
| alpha                                                                       | 4.1486  | 4.1627  | 4.1770  | 4.2503  | 4.2654  | 4.3429  | 4.3429  | 4.3588  | 4.3115  | 4.2654  | 4.2354  | 4.2059       |
| util living area                                                            | 0.9549  | 0.9250  | 0.8491  | 0.6807  | 0.4871  | 0.3292  | 0.2406  | 0.2845  | 0.5018  | 0.7920  | 0.9250  | 0.9614 (86)  |
| MIT                                                                         | 20.0146 | 20.2268 | 20.5476 | 20.8531 | 20.9684 | 20.9956 | 20.9991 | 20.9983 | 20.9749 | 20.7720 | 20.3562 | 19.9854 (87) |
| Th 2                                                                        | 20.4407 | 20.4430 | 20.4454 | 20.4573 | 20.4597 | 20.4716 | 20.4716 | 20.4740 | 20.4668 | 20.4597 | 20.4549 | 20.4502 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9499  | 0.9172  | 0.8350  | 0.6584  | 0.4612  | 0.3025  | 0.2119  | 0.2522  | 0.4663  | 0.7688  | 0.9160  | 0.9571 (89)  |
| MIT 2                                                                       | 19.0952 | 19.4003 | 19.8535 | 20.2763 | 20.4242 | 20.4674 | 20.4709 | 20.4726 | 20.4412 | 20.1795 | 19.5979 | 19.0603 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.4056 | 19.6794 | 20.0879 | 20.4711 | 20.6079 | 20.6458 | 20.6493 | 20.6501 | 20.6214 | 20.3796 | 19.8539 | 19.3727 (91) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 19.4056 | 19.6794 | 20.0879 | 20.4711 | 20.6079 | 20.6458 | 20.6493 | 20.6501 | 20.6214 | 20.3796 | 19.8539 | 19.3727 (92) |
| fLA = Living area / (4) =                                                   |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             |         |         |         |         |         |         |         |         |         |         | 0.0000  | 19.3727 (93) |

#### 8. Space heating requirement

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9388   | 0.9049   | 0.8253   | 0.6590   | 0.4684   | 0.3113   | 0.2216   | 0.2630   | 0.4767   | 0.7652       | 0.9045   | 0.9468 (94)    |
| Useful gains         | 510.3557 | 561.1775 | 601.7587 | 582.4961 | 476.1360 | 321.6976 | 216.1786 | 225.5776 | 343.4811 | 454.8816     | 478.6834 | 489.4868 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 857.1684 | 834.9068 | 764.1483 | 636.0500 | 487.3997 | 323.1252 | 216.4219 | 226.0764 | 351.8576 | 535.0928     | 704.3065 | 845.5743 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 258.0286 | 183.9461 | 120.8179 | 38.5588  | 8.3802   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 59.6771      | 162.4486 | 264.9291 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1096.7863 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 11.3680 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1096.7863 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1151.6256 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2199.5428 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2309.5199 (310a) |
| Electricity used for heat distribution                                                  | 34.6115 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 161.8452 (330a)  |
| Total electricity for the above, kWh/year                                               | 161.8452 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 394.4078 (332)   |
| Total delivered energy for all uses                                                     | 4017.3986 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3643.3111          | 0.2160                        | 786.9552 (367)           |
| Electrical energy for heat distribution                                                    | 34.6115            | 0.5190                        | 17.9633 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 804.9185 (373)           |
| Space and water heating                                                                    |                    |                               | 804.9185 (376)           |
| Pumps and fans                                                                             | 161.8452           | 0.5190                        | 83.9977 (378)            |
| Energy for lighting                                                                        | 394.4078           | 0.5190                        | 204.6977 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1093.6139 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 11.3400 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 11.3400 ZC1 |
| Total Floor Area                                                                | TFA | 96.4800     |
| Assumed number of occupants                                                     | N   | 2.7045      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 15.3862 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.9062 ZC3  |
| Total CO2 emissions                                                             |     | 28.6324 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 28.6324 ZC8 |



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|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 96.4800 (1b)              | x 2.5000 (2b)                   | = 241.2000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 96.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 241.2000 (5)              |

|                                                      | main<br>heating              |   | secondary<br>heating |   | other |   | total                       | m3 per hour          |      |
|------------------------------------------------------|------------------------------|---|----------------------|---|-------|---|-----------------------------|----------------------|------|
| Number of chimneys                                   | 0                            | + | 0                    | + | 0     | = | 0 * 40 =                    | 0.0000               | (6a) |
| Number of open flues                                 | 0                            | + | 0                    | + | 0     | = | 0 * 20 =                    | 0.0000               | (6b) |
| Number of intermittent fans                          |                              |   |                      |   |       |   | 3 * 10 =                    | 30.0000              | (7a) |
| Number of passive vents                              |                              |   |                      |   |       |   | 0 * 10 =                    | 0.0000               | (7b) |
| Number of flueless gas fires                         |                              |   |                      |   |       |   | 0 * 40 =                    | 0.0000               | (7c) |
|                                                      |                              |   |                      |   |       |   |                             | Air changes per hour |      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |   |                      |   |       |   | 30.0000 / (5) =             | 0.1244               | (8)  |
| Pressure test                                        |                              |   |                      |   |       |   | Yes                         |                      |      |
| Measured/design AP50                                 |                              |   |                      |   |       |   |                             | 5.0000               |      |
| Infiltration rate                                    |                              |   |                      |   |       |   |                             | 0.3744               | (18) |
| Number of sides sheltered                            |                              |   |                      |   |       |   |                             | 2                    | (19) |
| Shelter factor                                       |                              |   |                      |   |       |   | (20) = 1 - [0.075 x (19)] = | 0.8500               | (20) |
| Infiltration rate adjusted to include shelter factor |                              |   |                      |   |       |   | (21) = (18) x (20) =        | 0.3182               | (21) |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4057 | 0.3978 | 0.3898 | 0.3500 | 0.3421 | 0.3023 | 0.3023 | 0.2944 | 0.3182 | 0.3421 | 0.3580 | 0.3739 (22b) |
| Effective ac    | 0.5823 | 0.5791 | 0.5760 | 0.5613 | 0.5585 | 0.5457 | 0.5457 | 0.5433 | 0.5506 | 0.5585 | 0.5641 | 0.5699 (25)  |

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K       | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------------|--------------|-------------------|---------------|---------|---------|---------|---------|---------|------|
| TER Opening Type (Uw = 1.40)                                        |             |                | 24.1200       | 1.3258                 | 31.9773      |                   |               | (27)    |         |         |         |         |      |
| External Wall 1                                                     | 49.3998     | 24.1200        | 25.2798       | 0.1800                 | 4.5504       |                   |               | (29a)   |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 49.3998       |                        |              |                   |               | (31)    |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               | (26) ... (30) + (32) = | 36.5276      |                   |               | (33)    |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                        |              |                   | 250.0000      | (35)    |         |         |         |         |      |
| Thermal Bridges (User defined value 0.050 * total exposed area)     |             |                |               |                        |              |                   | 2.4700        | (36)    |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |               |                        |              | (33) + (36) =     | 38.9976       | (37)    |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                        |              |                   |               |         |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar           | Apr                    | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 46.3495     | 46.0951        | 45.8457       | 44.6745                | 44.4553      | 43.4352           | 43.4352       | 43.2463 | 43.8281 | 44.4553 | 44.8986 | 45.3621 | (38) |
| Heat transfer coeff                                                 | 85.3471     | 85.0927        | 84.8434       | 83.6721                | 83.4530      | 82.4328           | 82.4328       | 82.2439 | 82.8258 | 83.4530 | 83.8963 | 84.3597 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                        |              |                   |               |         |         |         |         | 83.6710 | (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr                    | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.8846      | 0.8820         | 0.8794        | 0.8672                 | 0.8650       | 0.8544            | 0.8544        | 0.8524  | 0.8585  | 0.8650  | 0.8696  | 0.8744  | (40) |
| HLP (average)                                                       |             |                |               |                        |              |                   |               |         |         |         |         | 0.8672  | (40) |
| Days in month                                                       | 31          | 28             | 31            | 30                     | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31      | (41) |

|                                                             |          |          |          |          |          |          |         |          |          |          |                    |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|--------------------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |                    | 2.7045 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |                    | 98.4310 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov                | Dec            |
| Daily hot water use                                         |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                                             | 108.2741 | 104.3369 | 100.3996 | 96.4624  | 92.5251  | 88.5879  | 88.5879 | 92.5251  | 96.4624  | 100.3996 | 104.3369           | 108.2741 (44)  |
| Energy conte                                                | 160.5674 | 140.4332 | 144.9145 | 126.3400 | 121.2262 | 104.6090 | 96.9356 | 111.2351 | 112.5636 | 131.1820 | 143.1954           | 155.5009 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          | Total = Sum(45)m = | 1548.7030 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                                             | 24.0851  | 21.0650  | 21.7372  | 18.9510  | 18.1839  | 15.6914  | 14.5403 | 16.6853  | 16.8845  | 19.6773  | 21.4793            | 23.3251 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |                    |                |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |                    | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |                    | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |                    | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |                    | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325  | 22.5798  | 23.3325  | 22.5798            | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |          |         |          |          |          |                    |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 207.1623 | 182.5190 | 191.5094 | 171.4318 | 167.8211 | 149.7009 | 143.5305 | 157.8300 | 157.6554 | 177.7769 | 188.2872 | 202.0958 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 207.1623 | 182.5190 | 191.5094 | 171.4318 | 167.8211 | 149.7009 | 143.5305 | 157.8300 | 157.6554 | 177.7769 | 188.2872 | 202.0958 (64) |
|                                                                 | 90.6646  | 80.3626  | 85.4600  | 78.0815  | 77.5836  | 70.8560  | 69.5070  | 74.2616  | 73.5009  | 80.8939  | 83.6859  | 88.9800 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | 135.2232  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 22.3330   | 19.8360   | 16.1317   | 12.2127   | 9.1292    | 7.7072    | 8.3279    | 10.8250   | 14.5292   | 18.4482   | 21.5318   | 22.9537   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 250.5084  | 253.1079  | 246.5572  | 232.6117  | 215.0080  | 198.4629  | 187.4098  | 184.8103  | 191.3610  | 205.3065  | 222.9103  | 239.4553  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | 36.5223   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | -108.1785 | (71) |
| Water heating gains (Table 5)                                                       | 121.8610  | 119.5872  | 114.8656  | 108.4466  | 104.2791  | 98.4111   | 93.4234   | 99.8140   | 102.0845  | 108.7284  | 116.2305  | 119.5967  | (72) |
| Total internal gains                                                                | 461.2693  | 459.0980  | 444.1215  | 419.8379  | 394.9832  | 371.1482  | 355.7281  | 362.0162  | 374.5417  | 399.0501  | 427.2394  | 448.5727  | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          |          | 16.5600    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 57.1024 (75) |               |
| Northwest   |          |          |          |          | 7.5600     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 26.0685 (81) |               |
| Solar gains | 83.1709  | 169.2968 | 305.0190 | 500.9288 | 673.3466   | 717.8587                       | 671.5421                          | 535.3612                           | 371.6704                     | 206.8941 | 104.6505     | 67.9215 (83)  |
| Total gains | 544.4402 | 628.3948 | 749.1405 | 920.7667 | 1068.3297  | 1089.0069                      | 1027.2702                         | 897.3774                           | 746.2121                     | 605.9442 | 531.8900     | 516.4942 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 78.5029 | 78.7376 | 78.9691 | 80.0745 | 80.2848 | 81.2783 | 81.2783 | 81.4650 | 80.8927 | 80.2848 | 79.8605 | 79.4218 |              |
| alpha                                                                       | 6.2335  | 6.2492  | 6.2646  | 6.3383  | 6.3523  | 6.4186  | 6.4186  | 6.4310  | 6.3928  | 6.3523  | 6.3240  | 6.2948  |              |
| util living area                                                            | 0.9985  | 0.9958  | 0.9820  | 0.9011  | 0.6976  | 0.4821  | 0.3528  | 0.4206  | 0.7280  | 0.9668  | 0.9962  | 0.9989  | (86)         |
| MIT                                                                         | 20.0981 | 20.2384 | 20.4936 | 20.8125 | 20.9684 | 20.9973 | 20.9997 | 20.9991 | 20.9710 | 20.7104 | 20.3473 | 20.0763 | (87)         |
| Th 2                                                                        | 20.1806 | 20.1829 | 20.1851 | 20.1954 | 20.1974 | 20.2064 | 20.2064 | 20.2081 | 20.2029 | 20.1974 | 20.1934 | 20.1893 | (88)         |
| util rest of house                                                          | 0.9980  | 0.9945  | 0.9762  | 0.8747  | 0.6464  | 0.4234  | 0.2893  | 0.3487  | 0.6582  | 0.9525  | 0.9947  | 0.9985  | (89)         |
| MIT 2                                                                       | 18.9641 | 19.1703 | 19.5406 | 19.9855 | 20.1695 | 20.2048 | 20.2063 | 20.2078 | 20.1814 | 19.8609 | 19.3379 | 18.9388 | (90)         |
| Living area fraction                                                        | 19.3470 | 19.5310 | 19.8624 | 20.2647 | 20.4392 | 20.4724 | 20.4742 | 20.4750 | 20.4480 | 20.1478 | 19.6788 | 19.3229 | (91)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.3470 | 19.5310 | 19.8624 | 20.2647 | 20.4392 | 20.4724 | 20.4742 | 20.4750 | 20.4480 | 20.1478 | 19.6788 | 19.3229 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 0.9973    | 0.9930    | 0.9734    | 0.8772   | 0.6623   | 0.4432   | 0.3108   | 0.3731   | 0.6806   | 0.9514   | 0.9934    | 0.9980    | (94)  |
| Ext temp.            | 542.9470  | 624.0242  | 729.1996  | 807.7285 | 707.5209 | 482.5988 | 319.2421 | 334.7704 | 507.8704 | 576.5215 | 528.4034  | 515.4560  | (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Month fracti         | 1284.2206 | 1244.9895 | 1133.7114 | 950.9107 | 729.3148 | 484.0799 | 319.3639 | 335.1433 | 525.7784 | 796.7886 | 1055.3117 | 1275.7618 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating        | 551.5075  | 417.2887  | 300.9567  | 103.0912 | 16.2146  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.8787 | 379.3740  | 565.6675  | (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |           | 2497.9791 | (98)  |
|                      |           |           |           |          |          |          |          |          |          |          |           | 25.8912   | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2671.6354 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 551.5075 | 417.2887 | 300.9567 | 103.0912 | 16.2146  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.8787 | 379.3740 | 565.6675  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 589.8476 | 446.2981 | 321.8789 | 110.2580 | 17.3419  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 175.2714 | 405.7476 | 604.9920  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Water heating requirement                                             | 207.1623 | 182.5190 | 191.5094 | 171.4318 | 167.8211 | 149.7009 | 143.5305 | 157.8300 | 157.6554 | 177.7769 | 188.2872 | 202.0958  | (64)            |
| Efficiency of water heater                                            | 87.3035  | 86.9522  | 86.0149  | 83.5077  | 80.6400  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.5976  | 86.6464  | 87.4147   | (217)           |
| Fuel for water heating, kWh/month                                     | 237.2897 | 209.9072 | 222.6467 | 205.2887 | 208.1115 | 187.5951 | 179.8628 | 197.7819 | 197.5632 | 210.1440 | 217.3052 | 231.1920  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2504.6880 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2671.6354 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 394.4078  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5645.7312 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2671.6354          | 0.2160                        | 577.0732 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2504.6880          | 0.2160                        | 541.0126 (264)           |
| Space and water heating                                                                           |                    |                               | 1118.0859 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 394.4078           | 0.5190                        | 204.6977 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1361.7085 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.5888 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1217 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4035 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.5888 * 1.00) + 2.1217 + 0.4035, rounded to 2 d.p. |                    |                               | 14.1100 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |      |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|------|----------------|------------|
| Property Reference                 | INDEX_000366                        |               |              |      | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.06_3B |      |                |            |
| Property                           | A_2_14.06_3B, A_2_14.06_3B          |               |              |      |                |            |
|                                    |                                     |               |              |      |                |            |
| SAP Rating                         | 86 B                                | DER           | 12.91        | TER  | 13.20          |            |
| Environmental                      | 89 B                                | % DER<TER     | 2.23         |      |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.13                                | DFEE          | 37.17        | TFEE | 35.08          |            |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -5.98        |      |                |            |
|                                    |                                     |               |              |      |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              |      | Assessor ID    | Admin      |
| Client                             |                                     |               |              |      |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 103 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.20 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.91 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)35.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)37.2 kWh/m<sup>2</sup>/yrFail  
Excess energy =2.1 kWh/m<sup>2</sup>/yr (6.0%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

|                           |      |
|---------------------------|------|
| Secondary heating system: | None |
|---------------------------|------|

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                    |      |
|-----------------------------------|------------------------------------|------|
| Overheating risk (Thames Valley): | High                               | Fail |
| Based on:                         |                                    |      |
| Overshading:                      | Average                            |      |
| Windows facing North East:        | 13.20 m <sup>2</sup> , No overhang |      |
| Windows facing South East:        | 15.60 m <sup>2</sup> , No overhang |      |
| Air change rate:                  | 2.00 ach                           |      |
| Blinds/curtains:                  | None                               |      |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 102.8600 (1b)             | x 2.5000 (2b)                   | = 257.1500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 102.8600                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 257.1500 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|------------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 28.8000                | 1.3258           | 38.1818      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 66.5127       | 28.8000        | 37.7127                | 0.1600           | 6.0340       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 66.5127                |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26) ... (30) + (32) = |                  | 44.2159      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 102.8600               |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 102.8600               |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                        |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                        |                  |              |                   | 9.9769 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                        |                  |              |                   | 54.1928 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                        |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                    | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 23.4053       | 23.1348        | 22.8643                | 21.5119          | 21.2414      | 19.8889           | 19.8889       | 19.6185 | 20.4299 | 21.2414 | 21.7824 | 22.3234 (38) |
| Heat transfer coeff                                                 | 77.5981       | 77.3276        | 77.0571                | 75.7046          | 75.4341      | 74.0817           | 74.0817       | 73.8112 | 74.6227 | 75.4341 | 75.9751 | 76.5161 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                        |                  |              |                   |               |         |         |         |         | 75.6370 (39) |
|                                                                     | Jan           | Feb            | Mar                    | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.7544        | 0.7518         | 0.7491                 | 0.7360           | 0.7334       | 0.7202            | 0.7202        | 0.7176  | 0.7255  | 0.7334  | 0.7386  | 0.7439 (40)  |
| HLP (average)                                                       |               |                |                        |                  |              |                   |               |         |         |         |         | 0.7353 (40)  |
| Days in month                                                       | 31            | 28             | 31                     | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |              |             |             |             |             |             |             |              |              |                                   |
|------------------------------------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|-----------------------------------|
| Assumed occupancy                        |              |              |              |             |             |             |             |             |             |              |              | 2.7645 (42)                       |
| Average daily hot water use (litres/day) |              |              |              |             |             |             |             |             |             |              |              | 99.8562 (43)                      |
| Daily hot water use                      | Jan 109.8418 | Feb 105.8476 | Mar 101.8533 | Apr 97.8591 | May 93.8648 | Jun 89.8706 | Jul 89.8706 | Aug 93.8648 | Sep 97.8591 | Oct 101.8533 | Nov 105.8476 | Dec 109.8418 (44)                 |
| Energy conte                             | 162.8922     | 142.4666     | 147.0127     | 128.1693    | 122.9815    | 106.1237    | 98.3392     | 112.8456    | 114.1934    | 133.0814     | 145.2687     | 157.7524 (45)                     |
| Energy content (annual)                  |              |              |              |             |             |             |             |             |             |              |              | Total = Sum(45)m = 1571.1266 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 24.4338      | 21.3700      | 22.0519      | 19.2254     | 18.4472     | 15.9185     | 14.7509     | 16.9268     | 17.1290     | 19.9622      | 21.7903      | 23.6629 (46)                      |
| Water storage loss:                      |              |              |              |             |             |             |             |             |             |              |              | 110.0000 (47)                     |
| Store volume                             |              |              |              |             |             |             |             |             |             |              |              |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 218.1690 | 192.3940 | 202.2895 | 181.6630 | 178.2583 | 159.6173 | 153.6160 | 168.1224                                 | 167.6870 | 188.3582 | 198.7624 | 213.0292 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 218.1690 | 192.3940 | 202.2895 | 181.6630 | 178.2583 | 159.6173 | 153.6160 | 168.1224                                 | 167.6870 | 188.3582 | 198.7624 | 213.0292 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 2221.9664 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 98.3831  | 87.3121  | 93.1032  | 85.4112  | 85.1128  | 78.0811  | 76.9192  | 81.7426                                  | 80.7642  | 88.4710  | 91.0968  | 96.6741 (65)  |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 23.2568   | 20.6565   | 16.7990   | 12.7179   | 9.5068    | 8.0260    | 8.6724    | 11.2727   | 15.1302   | 19.2113   | 22.4224   | 23.9031 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 260.8702  | 263.5772  | 256.7556  | 242.2332  | 223.9013  | 206.6720  | 195.1617  | 192.4547  | 199.2763  | 213.7986  | 232.1305  | 249.3599 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 (71) |
| Water heating gains (Table 5)                                                       | 132.2354  | 129.9287  | 125.1387  | 118.6267  | 114.3989  | 108.4459  | 103.3860  | 109.8691  | 112.1726  | 118.9126  | 126.5233  | 129.9383 (72)  |
| Total internal gains                                                                | 480.8293  | 478.6294  | 463.1603  | 438.0449  | 412.2741  | 387.6110  | 371.6872  | 378.0635  | 391.0461  | 416.3896  | 445.5433  | 467.6684 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m <sup>2</sup> | Solar flux<br>Table 6a<br>W/m <sup>2</sup> | Specific data<br>or Table 6b |          | Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------------------|--------------------------------------------|------------------------------|----------|------------------------------|----------|------------------------------|----------|---------------|
| Northeast   |          |          |          | 13.2000                | 11.2829                                    | 0.3000                       |          | 0.8000                       |          | 0.7700                       |          | 24.7708 (75)  |
| Southeast   |          |          |          | 15.6000                | 36.7938                                    | 0.3000                       |          | 0.8000                       |          | 0.7700                       |          | 95.4650 (77)  |
| -----       |          |          |          |                        |                                            |                              |          |                              |          |                              |          |               |
| Solar gains | 120.2358 | 213.0339 | 313.3371 | 424.8716               | 509.3275                                   | 520.3516                     | 495.5539 | 430.2976                     | 351.6078 | 241.3405                     | 145.5132 | 101.9272 (83) |
| Total gains | 601.0652 | 691.6633 | 776.4973 | 862.9165               | 921.6015                                   | 907.9625                     | 867.2411 | 808.3611                     | 742.6538 | 657.7301                     | 591.0564 | 569.5957 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 36.8208 | 36.9496 | 37.0793 | 37.7417 | 37.8770 | 38.5685 | 38.5685 | 38.7099 | 38.2889 | 37.8770 | 37.6073 | 37.3414      |
| alpha                                                                       | 3.4547  | 3.4633  | 3.4720  | 3.5161  | 3.5251  | 3.5712  | 3.5712  | 3.5807  | 3.5526  | 3.5251  | 3.5072  | 3.4894       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9610  | 0.9374  | 0.8927  | 0.8012  | 0.6632  | 0.4963  | 0.3687  | 0.4089  | 0.6220  | 0.8420  | 0.9380  | 0.9666 (86)  |
| MIT                                                                         | 19.5543 | 19.7979 | 20.1445 | 20.5445 | 20.8167 | 20.9521 | 20.9872 | 20.9816 | 20.8921 | 20.5317 | 19.9838 | 19.5145 (87) |
| Th 2                                                                        | 20.2930 | 20.2953 | 20.2976 | 20.3091 | 20.3115 | 20.3230 | 20.3230 | 20.3253 | 20.3184 | 20.3115 | 20.3068 | 20.3022 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9561  | 0.9299  | 0.8800  | 0.7789  | 0.6286  | 0.4500  | 0.3144  | 0.3525  | 0.5749  | 0.8190  | 0.9293  | 0.9624 (89)  |
| MIT 2                                                                       | 18.3287 | 18.6801 | 19.1753 | 19.7402 | 20.1024 | 20.2771 | 20.3136 | 20.3111 | 20.2077 | 19.7349 | 18.9595 | 18.2775 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 18.7115 | 19.0293 | 19.4780 | 19.9914 | 20.3255 | 20.4879 | 20.5240 | 20.5205 | 20.4215 | 19.9838 | 19.2794 | 18.6639 (92) |
| fLA = Living area / (4) =                                                   |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.7115 | 19.0293 | 19.4780 | 19.9914 | 20.3255 | 20.4879 | 20.5240 | 20.5205 | 20.4215 | 19.9838 | 19.2794 | 18.6639 (93) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 18.7115 | 19.0293 | 19.4780 | 19.9914 | 20.3255 | 20.4879 | 20.5240 | 20.5205 | 20.4215 | 19.9838 | 19.2794 | 18.6639 (93) |
| adjusted MIT                                                                |         |         |         |         |         |         |         |         |         |         |         |              |

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | 0.9422    | 0.9134    | 0.8629    | 0.7678   | 0.6293   | 0.4615   | 0.3307   | 0.3691   | 0.5823   | 0.8067   | 0.9135   | 0.9496 (94)               |
| Useful gains         | 566.3313  | 631.7838  | 670.0526  | 662.5656 | 579.9588 | 419.0581 | 286.7716 | 298.3482 | 432.4271 | 530.5870 | 539.9485 | 540.9147 (95)             |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Heat loss rate W     |           |           |           |          |          |          |          |          |          |          |          |                           |
|                      | 1118.3051 | 1092.5836 | 1000.0507 | 839.6719 | 650.6582 | 436.1886 | 290.6963 | 304.1419 | 471.7256 | 707.8587 | 925.3347 | 1106.7234 (97)            |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating kWh    |           |           |           |          |          |          |          |          |          |          |          |                           |
|                      | 410.6685  | 309.6575  | 245.5185  | 127.5166 | 52.6003  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 131.8901 | 277.4781 | 420.9616 (98)             |
| Space heating        |           |           |           |          |          |          |          |          |          |          |          | 1976.2913 (98)            |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |          | (98) / (4) = 19.2134 (99) |

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8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 1976.2913 | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 2075.1059 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 2221.9664 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2333.0647 | (310a) |
| Electricity used for heat distribution                                                  | 44.0817   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |           |        |
| mechanical ventilation fans (SFP = 0.5500)                                              | 172.5477  | (330a) |
| Total electricity for the above, kWh/year                                               | 172.5477  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 410.7217  | (332)  |
| Total delivered energy for all uses                                                     | 4991.4399 | (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 4640.1795          | 0.2160                        | 1002.2788 (367)          |
| Electrical energy for heat distribution                                                    | 44.0817            | 0.5190                        | 22.8784 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1025.1572 (373)          |
| Space and water heating                                                                    |                    |                               | 1025.1572 (376)          |
| Pumps and fans                                                                             | 172.5477           | 0.5190                        | 89.5522 (378)            |
| Energy for lighting                                                                        | 410.7217           | 0.5190                        | 213.1646 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1327.8740 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.9100 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.9100 ZC1 |
| Total Floor Area                                                                | TFA | 102.8600    |
| Assumed number of occupants                                                     | N   | 2.7645      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 15.0288 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.8019 ZC3  |
| Total CO2 emissions                                                             |     | 29.7407 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 29.7407 ZC8 |



SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
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|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 102.8600 (1b)             | 2.5000 (2b)                     | 257.1500 (1b) - (3b)        |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 102.8600                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | 257.1500 (5)                |

|                                                      | main<br>heating              |   | secondary<br>heating |   | other |   | total                       | m3 per hour          |
|------------------------------------------------------|------------------------------|---|----------------------|---|-------|---|-----------------------------|----------------------|
| Number of chimneys                                   | 0                            | + | 0                    | + | 0     | = | 0 * 40 =                    | 0.0000 (6a)          |
| Number of open flues                                 | 0                            | + | 0                    | + | 0     | = | 0 * 20 =                    | 0.0000 (6b)          |
| Number of intermittent fans                          |                              |   |                      |   |       |   | 4 * 10 =                    | 40.0000 (7a)         |
| Number of passive vents                              |                              |   |                      |   |       |   | 0 * 10 =                    | 0.0000 (7b)          |
| Number of flueless gas fires                         |                              |   |                      |   |       |   | 0 * 40 =                    | 0.0000 (7c)          |
|                                                      |                              |   |                      |   |       |   |                             | Air changes per hour |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |   |                      |   |       |   | 40.0000 / (5) =             | 0.1556 (8)           |
| Pressure test                                        |                              |   |                      |   |       |   | Yes                         |                      |
| Measured/design AP50                                 |                              |   |                      |   |       |   | 5.0000                      |                      |
| Infiltration rate                                    |                              |   |                      |   |       |   | 0.4056                      | (18)                 |
| Number of sides sheltered                            |                              |   |                      |   |       |   | 2                           | (19)                 |
| Shelter factor                                       |                              |   |                      |   |       |   | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)          |
| Infiltration rate adjusted to include shelter factor |                              |   |                      |   |       |   | (21) = (18) x (20) =        | 0.3447 (21)          |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4395 | 0.4309 | 0.4223 | 0.3792 | 0.3706 | 0.3275 | 0.3275 | 0.3189 | 0.3447 | 0.3706 | 0.3878 | 0.4050 (22b) |
| Effective ac    | 0.5966 | 0.5928 | 0.5892 | 0.5719 | 0.5687 | 0.5536 | 0.5536 | 0.5508 | 0.5594 | 0.5687 | 0.5752 | 0.5820 (25)  |

|                                                                     |                |                |                |                        |                  |                |                   |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|------|
| Element                                                             |                | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                |                | 25.7100                | 1.3258           | 34.0852        |                   | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 66.5127        | 25.7100        |                | 40.8027                | 0.1800           | 7.3445         |                   | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                |                | 66.5127                |                  |                |                   | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26) ... (30) + (32) = |                  | 41.4297        |                   | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                        |                  |                |                   |                | 250.0000 (35)  |                |                |                |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                |                |                |                        |                  |                |                   |                | 3.3256 (36)    |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                        |                  |                | (33) + (36) =     |                | 44.7553 (37)   |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                        |                  |                |                   |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>50.6261 | Feb<br>50.3078 | Mar<br>49.9958 | Apr<br>48.5305         | May<br>48.2564   | Jun<br>46.9801 | Jul<br>46.9801    | Aug<br>46.7438 | Sep<br>47.4717 | Oct<br>48.2564 | Nov<br>48.8110 | Dec<br>49.3908 | (38) |
| Heat transfer coeff                                                 | 95.3814        | 95.0632        | 94.7512        | 93.2859                | 93.0117          | 91.7355        | 91.7355           | 91.4991        | 92.2271        | 93.0117        | 93.5663        | 94.1462        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                        |                  |                |                   |                |                |                |                | 93.2846        | (39) |
| HLP                                                                 | Jan<br>0.9273  | Feb<br>0.9242  | Mar<br>0.9212  | Apr<br>0.9069          | May<br>0.9043    | Jun<br>0.8918  | Jul<br>0.8918     | Aug<br>0.8896  | Sep<br>0.8966  | Oct<br>0.9043  | Nov<br>0.9096  | Dec<br>0.9153  | (40) |
| HLP (average)                                                       |                |                |                |                        |                  |                |                   |                |                |                |                | 0.9069         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30                     | 31               | 30             | 31                | 31             | 30             | 31             | 30             | 31             | (41) |

|                                                             |          |          |          |          |          |          |         |          |          |          |            |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|------------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |            | 2.7645 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |            | 99.8562 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov        | Dec            |
| Daily hot water use                                         |          |          |          |          |          |          |         |          |          |          |            |                |
|                                                             | 109.8418 | 105.8476 | 101.8533 | 97.8591  | 93.8648  | 89.8706  | 89.8706 | 93.8648  | 97.8591  | 101.8533 | 105.8476   | 109.8418 (44)  |
| Energy content (annual)                                     | 162.8922 | 142.4666 | 147.0127 | 128.1693 | 122.9815 | 106.1237 | 98.3392 | 112.8456 | 114.1934 | 133.0814 | 145.2687   | 157.7524 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |          |         |          |          | Total =  | Sum(45)m = | 1571.1266 (45) |
|                                                             | 24.4338  | 21.3700  | 22.0519  | 19.2254  | 18.4472  | 15.9185  | 14.7509 | 16.9268  | 17.1290  | 19.9622  | 21.7903    | 23.6629 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |            |                |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |            | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |            | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |            | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |            | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |          |         |          |          |          |            |                |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325  | 22.5798  | 23.3325  | 22.5798    | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |          |         |          |          |          |            |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                                   | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 209.4871 | 184.5523 | 193.6076 | 173.2611 | 169.5764 | 151.2155 | 144.9341 | 159.4405                                  | 159.2852 | 179.6763 | 190.3606 | 204.3473 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          | 0.0000 (63)    |
|                                                                 | 209.4871 | 184.5523 | 193.6076 | 173.2611 | 169.5764 | 151.2155 | 144.9341 | 159.4405                                  | 159.2852 | 179.6763 | 190.3606 | 204.3473 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          | 2119.7440 (64) |
|                                                                 | 91.4376  | 81.0387  | 86.1577  | 78.6898  | 78.1673  | 71.3596  | 69.9737  | 74.7971                                   | 74.0428  | 81.5255  | 84.3753  | 89.7286 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235  | 138.2235 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 23.2568   | 20.6565   | 16.7990   | 12.7179   | 9.5068    | 8.0260    | 8.6724    | 11.2727   | 15.1302   | 19.2113   | 22.4224   | 23.9031 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 260.8702  | 263.5772  | 256.7556  | 242.2332  | 223.9013  | 206.6720  | 195.1617  | 192.4547  | 199.2763  | 213.7986  | 232.1305  | 249.3599 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224   | 36.8224 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 | -110.5788 (71) |
| Water heating gains (Table 5)                                                       | 122.9000  | 120.5933  | 115.8033  | 109.2913  | 105.0635  | 99.1105   | 94.0507   | 100.5337  | 102.8372  | 109.5773  | 117.1879  | 120.6030 (72)  |
| Total internal gains                                                                | 474.4940  | 472.2940  | 456.8249  | 431.7095  | 405.9387  | 381.2756  | 365.3518  | 371.7282  | 384.7107  | 410.0542  | 439.2079  | 461.3330 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|-----------|------------|--------------------------------|-----------------------------------|-----------|------------------------------------|------------------------------|----------|---------------|
| Northeast   |          |          |          |           | 11.7800    | 11.2829                        | 0.6300                            |           | 0.7000                             | 0.7700                       |          | 40.6200 (75)  |
| Southeast   |          |          |          |           | 13.9300    | 36.7938                        | 0.6300                            |           | 0.7000                             | 0.7700                       |          | 156.6383 (77) |
|             |          |          |          |           |            |                                |                                   |           |                                    |                              |          |               |
| Solar gains | 197.2583 | 349.4961 | 514.0338 | 696.9827  | 835.5078   | 853.5833                       | 812.9088                          | 705.8758  | 576.8090                           | 395.9305                     | 238.7270 | 167.2220 (83) |
| Total gains | 671.7522 | 821.7901 | 970.8587 | 1128.6922 | 1241.4465  | 1234.8589                      | 1178.2606                         | 1077.6039 | 961.5197                           | 805.9847                     | 677.9349 | 628.5551 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 74.8894 | 75.1401 | 75.3875 | 76.5717 | 76.7974 | 77.8658 | 77.8658 | 78.0669 | 77.4508 | 76.7974 | 76.3422 | 75.8720      |
| alpha                                                                       | 5.9926  | 6.0093  | 6.0258  | 6.1048  | 6.1198  | 6.1911  | 6.1911  | 6.2045  | 6.1634  | 6.1198  | 6.0895  | 6.0581       |
| util living area                                                            | 0.9967  | 0.9888  | 0.9603  | 0.8593  | 0.6717  | 0.4729  | 0.3423  | 0.3899  | 0.6433  | 0.9249  | 0.9909  | 0.9977 (86)  |
| MIT                                                                         | 20.1213 | 20.3164 | 20.5793 | 20.8482 | 20.9703 | 20.9970 | 20.9997 | 20.9993 | 20.9829 | 20.7879 | 20.3996 | 20.0896 (87) |
| Th 2                                                                        | 20.1444 | 20.1470 | 20.1495 | 20.1616 | 20.1639 | 20.1744 | 20.1744 | 20.1764 | 20.1704 | 20.1639 | 20.1593 | 20.1545 (88) |
| util rest of house                                                          | 0.9957  | 0.9854  | 0.9489  | 0.8266  | 0.6193  | 0.4131  | 0.2782  | 0.3205  | 0.5734  | 0.8982  | 0.9875  | 0.9970 (89)  |
| MIT 2                                                                       | 18.9702 | 19.2549 | 19.6304 | 19.9972 | 20.1380 | 20.1726 | 20.1743 | 20.1761 | 20.1584 | 19.9320 | 19.3867 | 18.9316 (90) |
| Living area fraction                                                        | 19.3298 | 19.5865 | 19.9268 | 20.2630 | 20.3980 | 20.4302 | 20.4321 | 20.4332 | 20.4160 | 20.1994 | 19.7031 | 19.2933 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.3298 | 19.5865 | 19.9268 | 20.2630 | 20.3980 | 20.4302 | 20.4321 | 20.4332 | 20.4160 | 20.1994 | 19.7031 | 19.2933 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
| Useful gains         | 667.9328  | 807.4500  | 917.8136  | 937.8254  | 787.4916 | 533.1219 | 351.4038 | 368.7233 | 571.7480 | 724.9911     | 667.8334  | 626.0430 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000 (96)    |
| Heat loss rate W     | 1433.5602 | 1396.1453 | 1272.2032 | 1060.0072 | 809.0161 | 534.8317 | 351.5419 | 369.0378 | 582.5035 | 892.8562     | 1179.2233 | 1420.9782 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating kWh    | 569.6268  | 395.6032  | 263.6658  | 87.9709   | 16.0142  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.8916     | 368.2007  | 591.4318 (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 2417.4051 (98) |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 23.5019 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2585.4599 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 569.6268 | 395.6032 | 263.6658 | 87.9709  | 16.0142  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.8916 | 368.2007 | 591.4318  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 609.2265 | 423.1051 | 281.9956 | 94.0865  | 17.1275  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 133.5739 | 393.7976 | 632.5474  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 209.4871 | 184.5523 | 193.6076 | 173.2611 | 169.5764 | 151.2155 | 144.9341 | 159.4405 | 159.2852 | 179.6763 | 190.3606 | 204.3473  | (64)            |
| Efficiency of water heater                                            | 87.3508  | 86.7978  | 85.6382  | 83.1090  | 80.6225  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.8660  | 86.5452  | 87.4877   | (217)           |
| Fuel for water heating, kWh/month                                     | 239.8229 | 212.6233 | 226.0762 | 208.4746 | 210.3338 | 189.4931 | 181.6216 | 199.8002 | 199.6055 | 214.2420 | 219.9552 | 233.5727  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2535.6211 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2585.4599 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 410.7217  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5606.8028 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2585.4599          | 0.2160                        | 558.4593 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2535.6211          | 0.2160                        | 547.6942 (264)           |
| Space and water heating                                                                           |                    |                               | 1106.1535 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 410.7217           | 0.5190                        | 213.1646 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1358.2431 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 10.7540 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.0724 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.3784 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (10.7540 * 1.00) + 2.0724 + 0.3784, rounded to 2 d.p. |                    |                               | 13.2000 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000438                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.07_2B |                |            |
| Property                           | A_2_14.07_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 13.67        | TER            | 13.96      |
| Environmental                      | 90 B                                | % DER<TER     | 2.05         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.83                                | DFEE          | 31.64        | TFEE           | 28.27      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -11.93       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 69 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.96 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 13.67 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)28.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)31.6 kWh/m<sup>2</sup>/yrFail  
Excess energy =3.3 kWh/m<sup>2</sup>/yr (11.7%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

|                           |      |
|---------------------------|------|
| Secondary heating system: | None |
|---------------------------|------|

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 2.40 m <sup>2</sup> , No overhang  |
| Windows facing South East: | 15.60 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 18.0000              | 1.3258           | 23.8636      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 36.8672       | 18.0000        | 18.8672              | 0.1600           | 3.0188       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 36.8672              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...(30) + (32) = |                  | 26.8824      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 68.8700              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 68.8700              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                      |                  |              |                   | 5.5301 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                      |                  |              |                   | 32.4125 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 15.6710       | 15.4899        | 15.3088              | 14.4033          | 14.2222      | 13.3167           | 13.3167       | 13.1356 | 13.6789 | 14.2222 | 14.5844 | 14.9466 (38) |
| Heat transfer coeff                                                 | 48.0835       | 47.9024        | 47.7213              | 46.8158          | 46.6347      | 45.7291           | 45.7291       | 45.5480 | 46.0913 | 46.6347 | 46.9969 | 47.3591 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                      |                  |              |                   |               |         |         |         |         | 46.7705 (39) |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.6982        | 0.6955         | 0.6929               | 0.6798           | 0.6771       | 0.6640            | 0.6640        | 0.6614  | 0.6693  | 0.6771  | 0.6824  | 0.6877 (40)  |
| HLP (average)                                                       |               |                |                      |                  |              |                   |               |         |         |         |         | 0.6791 (40)  |
| Days in month                                                       | 31            | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.2184 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 86.8865 (43)                      |
| Daily hot water use                      | Jan 95.5752 | Feb 92.0997 | Mar 88.6243 | Apr 85.1488 | May 81.6734 | Jun 78.1979 | Jul 78.1979 | Aug 81.6734 | Sep 85.1488 | Oct 88.6243 | Nov 92.0997 | Dec 95.5752 (44)                  |
| Energy conte                             | 141.7353    | 123.9626    | 127.9183    | 111.5222    | 107.0082    | 92.3400     | 85.5666     | 98.1889     | 99.3616     | 115.7963    | 126.4008    | 137.2630 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 21.2603     | 18.5944     | 19.1877     | 16.7283     | 16.0512     | 13.8510     | 12.8350     | 14.7283     | 14.9042     | 17.3695     | 18.9601     | 20.5895 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|-----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)                             |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)                             |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)                             |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)                             |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)                            |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)                            |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)                            |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (62)                           |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)                             |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |                                         | 0.0000 (63)    |
| Output from w/h                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (64)                           |                |
|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          | Total per year (kWh/year) = Sum (64)m = | 2017.9035 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 91.3484  | 81.1595  | 86.7543  | 79.8761  | 79.8017  | 73.4980  | 72.6723  | 76.8692                                   | 75.8327  | 82.7237  | 84.8232  | 89.8614 (65)                            |                |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.3528  | 15.4126  | 12.5344  | 9.4893   | 7.0934   | 5.9885   | 6.4708   | 8.4110   | 11.2892  | 14.3343  | 16.7302  | 17.8351 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 194.6455 | 196.6653 | 191.5754 | 180.7397 | 167.0616 | 154.2061 | 145.6178 | 143.5980 | 148.6878 | 159.5235 | 173.2017 | 186.0572 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 (71) |
| Water heating gains (Table 5)                                                       | 122.7801 | 120.7731 | 116.6052 | 110.9390 | 107.2603 | 102.0805 | 97.6779  | 103.3189 | 105.3231 | 111.1878 | 117.8100 | 120.7815 (72) |
| Total internal gains                                                                | 391.0541 | 389.1266 | 376.9907 | 357.4438 | 337.6910 | 318.5508 | 306.0422 | 311.6036 | 321.5759 | 341.3213 | 364.0176 | 380.9494 (73) |

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 2.4000     | 11.2829                        | 0.3000                            | 0.8000                             | 0.7700                       | 4.5038 (75)  |
| Southeast | 15.6000    | 36.7938                        | 0.3000                            | 0.8000                             | 0.7700                       | 95.4650 (77) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 940.8088 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 987.8493 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2017.9035 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2118.7987 (310a) |
| Electricity used for heat distribution                                                  | 31.0665 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 115.5294 (330a)  |
| Total electricity for the above, kWh/year                                               | 115.5294 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 306.4556 (332)   |
| Total delivered energy for all uses                                                     | 3528.6330 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3270.1557          | 0.2160                        | 706.3536 (367)           |
| Electrical energy for heat distribution                                                    | 31.0665            | 0.5190                        | 16.1235 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 722.4771 (373)           |
| Space and water heating                                                                    |                    |                               | 722.4771 (376)           |
| Pumps and fans                                                                             | 115.5294           | 0.5190                        | 59.9598 (378)            |
| Energy for lighting                                                                        | 306.4556           | 0.5190                        | 159.0505 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 941.4874 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 13.6700 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 13.6700 ZC1 |
| Total Floor Area                                                                | TFA | 68.8700     |
| Assumed number of occupants                                                     | N   | 2.2184      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.7479 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5010 ZC3  |
| Total CO2 emissions                                                             |     | 32.9189 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 32.9189 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1162 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.3662 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3112 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3968 | 0.3890 | 0.3813 | 0.3424 | 0.3346 | 0.2957 | 0.2957 | 0.2879 | 0.3112 | 0.3346 | 0.3501 | 0.3657 (22b) |
| Effective ac    | 0.5787 | 0.5757 | 0.5727 | 0.5586 | 0.5560 | 0.5437 | 0.5437 | 0.5414 | 0.5484 | 0.5560 | 0.5613 | 0.5669 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|----------------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 17.2200                   | 1.3258                        | 22.8295              |                                | (27)          |
| External Wall 1                                                     | 36.8672                 | 17.2200                    | 19.6472                   | 0.1800                        | 3.5365               |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 36.8672                   |                               |                      |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            |                           |                               | (26)...(30) + (32) = | 26.3660                        | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |                      |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |                      |                                | 1.8434 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |                      | (33) + (36) =                  | 28.2094 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |                      |                                |               |
| (38)m                                                               | 32.8825                 | 32.7087                    | 32.5385                   | 31.7387                       | 31.5891              | 30.8925                        | 30.8925       |
| Heat transfer coeff                                                 | 61.0919                 | 60.9182                    | 60.7479                   | 59.9481                       | 59.7985              | 59.1019                        | 59.1019       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |                      | 58.9729                        | 59.3702       |
|                                                                     |                         |                            |                           |                               |                      | 59.7985                        | 59.7985       |
|                                                                     |                         |                            |                           |                               |                      | 60.1012                        | 60.1012       |
|                                                                     |                         |                            |                           |                               |                      | 60.4176                        | 60.4176 (39)  |
|                                                                     |                         |                            |                           |                               |                      | 59.9474                        | 59.9474 (39)  |
| HLP                                                                 | 0.8871                  | 0.8845                     | 0.8821                    | 0.8705                        | 0.8683               | 0.8582                         | 0.8582        |
| HLP (average)                                                       |                         |                            |                           |                               |                      | 0.8563                         | 0.8621        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31                   | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |                      | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |                      | 31                             | 30            |
|                                                                     |                         |                            |                           |                               |                      | 31                             | 30            |
|                                                                     |                         |                            |                           |                               |                      | 31                             | 31            |
|                                                                     |                         |                            |                           |                               |                      | 31                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.2184 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.8865 (43)   |
| Daily hot water use                                         | 95.5752  | 92.0997  | 88.6243  | 85.1488  | 81.6734  | 78.1979 | 78.1979 | 81.6734 | 85.1488 | 88.6243            | 92.0997  | 95.5752 (44)   |
| Energy conte                                                | 141.7353 | 123.9626 | 127.9183 | 111.5222 | 107.0082 | 92.3400 | 85.5666 | 98.1889 | 99.3616 | 115.7963           | 126.4008 | 137.2630 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.2603  | 18.5944  | 19.1877  | 16.7283  | 16.0512  | 13.8510 | 12.8350 | 14.7283 | 14.9042 | 17.3695            | 18.9601  | 20.5895 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838                      | 144.4534    | 162.3912 | 171.4926 | 183.8579 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
|                                                                 | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838                      | 144.4534    | 162.3912 | 171.4926 | 183.8579 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1915.6811 (64) |
|                                                                 | 84.4029  | 74.8861  | 79.8087  | 73.1546  | 72.8562  | 66.7765  | 65.7268  | 69.9237                       | 69.1112     | 75.7782  | 78.1017  | 82.9159 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 17.3528  | 15.4126  | 12.5344  | 9.4893   | 7.0934   | 5.9885   | 6.4708   | 8.4110   | 11.2892  | 14.3343  | 16.7302  | 17.8351 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 194.6455 | 196.6653 | 191.5754 | 180.7397 | 167.0616 | 154.2061 | 145.6178 | 143.5980 | 148.6878 | 159.5235 | 173.2017 | 186.0572 (68) |
| Pumps, fans                                                                         | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 (71) |
| Total internal gains                                                                | 113.4448 | 111.4377 | 107.2698 | 101.6036 | 97.9250  | 92.7452  | 88.3425  | 93.9835  | 95.9878  | 101.8524 | 108.4746 | 111.4461 (72) |
|                                                                                     | 384.7187 | 382.7913 | 370.6553 | 351.1084 | 331.3556 | 312.2155 | 299.7068 | 305.2682 | 315.2406 | 334.9860 | 357.6822 | 374.6141 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|---------------|---------------|
| Northeast   |          |          |          | 2.3000     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 7.9309 (75)   |               |
| Southeast   |          |          |          | 14.9200    | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 167.7705 (77) |               |
| -----       |          |          |          |            |                                |                                   |                                    |                              |          |          |               |               |
| Solar gains | 175.7014 | 301.9188 | 420.0958 | 532.2474   | 606.8667                       | 607.1870                          | 583.4334                           | 527.0442                     | 458.8226 | 335.5713 | 210.9295      | 150.0534 (83) |
| Total gains | 560.4201 | 684.7101 | 790.7511 | 883.3558   | 938.2223                       | 919.4024                          | 883.1402                           | 832.3124                     | 774.0631 | 670.5572 | 568.6118      | 524.6674 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 78.2860 | 78.5093 | 78.7293 | 79.7797 | 79.9793 | 80.9219 | 80.9219 | 81.0989 | 80.5562                   | 79.9793 | 79.5765 | 79.1596      |
| alpha                                                                       | 6.2191  | 6.2340  | 6.2486  | 6.3186  | 6.3320  | 6.3948  | 6.3948  | 6.4066  | 6.3704                    | 6.3320  | 6.3051  | 6.2773       |
| util living area                                                            | 0.9890  | 0.9653  | 0.9039  | 0.7658  | 0.5837  | 0.4106  | 0.2944  | 0.3258  | 0.5249                    | 0.8290  | 0.9700  | 0.9923 (86)  |
| MIT                                                                         | 20.3326 | 20.5417 | 20.7619 | 20.9297 | 20.9879 | 20.9989 | 20.9999 | 20.9998 | 20.9951                   | 20.9051 | 20.5923 | 20.2905 (87) |
| Th 2                                                                        | 20.1785 | 20.1807 | 20.1828 | 20.1927 | 20.1945 | 20.2032 | 20.2032 | 20.2048 | 20.1999                   | 20.1945 | 20.1908 | 20.1869 (88) |
| util rest of house                                                          | 0.9858  | 0.9563  | 0.8826  | 0.7275  | 0.5362  | 0.3599  | 0.2411  | 0.2695  | 0.4659                    | 0.7881  | 0.9605  | 0.9900 (89)  |
| MIT 2                                                                       | 19.3025 | 19.6012 | 19.9029 | 20.1204 | 20.1844 | 20.2026 | 20.2032 | 20.2047 | 20.1966                   | 20.0992 | 19.6847 | 19.2485 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4703 (91)  |
| MIT                                                                         | 19.7870 | 20.0435 | 20.3069 | 20.5010 | 20.5623 | 20.5771 | 20.5779 | 20.5787 | 20.5722                   | 20.4782 | 20.1115 | 19.7386 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.7870 | 20.0435 | 20.3069 | 20.5010 | 20.5623 | 20.5771 | 20.5779 | 20.5787 | 20.5722                   | 20.4782 | 20.1115 | 19.7386 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9839   | 0.9545   | 0.8861   | 0.7426   | 0.5581   | 0.3837   | 0.2662   | 0.2960   | 0.4935   | 0.8033       | 0.9595   | 0.9884 (94)    |
| Ext temp.            | 551.4168 | 653.5872 | 700.6752 | 655.9553 | 523.6578 | 352.7766 | 235.0633 | 246.3563 | 382.0076 | 538.6344     | 545.5577 | 518.5781 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 946.1280 | 922.5151 | 838.7399 | 695.4604 | 529.9491 | 353.2568 | 235.0998 | 246.4275 | 384.2545 | 590.7022     | 782.0083 | 938.8043 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 293.6651 | 180.7195 | 102.7201 | 28.4437  | 4.6808   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 38.7385      | 170.2444 | 312.6483 (98)  |
|                      |          |          |          |          |          |          |          |          |          |              |          | 1131.8605 (98) |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 16.4347 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1210.5460 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 293.6651 | 180.7195 | 102.7201 | 28.4437  | 4.6808   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 38.7385  | 170.2444 | 312.6483  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 314.0804 | 193.2829 | 109.8611 | 30.4210  | 5.0062   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 41.4315  | 182.0796 | 334.3833  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838 | 144.4534 | 162.3912 | 171.4926 | 183.8579  | (64)            |
| Efficiency of water heater (217)m                                     | 85.9946  | 85.0399  | 83.4560  | 81.2770  | 80.0800  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.6596  | 84.7944  | 86.2190   | (217)           |
| Fuel for water heating, kWh/month                                     | 219.0022 | 195.2592 | 209.1081 | 192.6918 | 191.8122 | 172.2203 | 165.6159 | 181.4333 | 181.0193 | 198.8637 | 202.2452 | 213.2452  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2322.5164 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1210.5460 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 306.4556  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3914.5179 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1210.5460          | 0.2160                        | 261.4779 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2322.5164          | 0.2160                        | 501.6635 (264)           |
| Space and water heating                                                                           |                    |                               | 763.1415 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 306.4556           | 0.5190                        | 159.0505 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 961.1169 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.0809 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3094 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5652 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.0809 * 1.00) + 2.3094 + 0.5652, rounded to 2 d.p. |                    |                               | 13.9600 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000482                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.07_2B |                |            |
| Property                           | A_2_14.07_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 12.02        | TER            | 13.96      |
| Environmental                      | 91 B                                | % DER<TER     | 13.87        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.76                                | DFEE          | 24.26        | TFEE           | 28.27      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 14.17        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 69 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.96 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.02 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)28.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)24.3 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 2.40 m <sup>2</sup> , No overhang  |
| Windows facing South East: | 15.60 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    | secondary | other   |        |        | total                        | m3 per hour          |                |            |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|-----------|---------|--------|--------|------------------------------|----------------------|----------------|------------|
|                                                                                              |        |        |        |        | heating |           | heating |        |        |                              |                      |                |            |
| Number of chimneys                                                                           |        |        |        |        | 0       | +         | 0       | +      | 0      | =                            | 0 * 40 =             | 0.0000 (6a)    |            |
| Number of open flues                                                                         |        |        |        |        | 0       | +         | 0       | +      | 0      | =                            | 0 * 20 =             | 0.0000 (6b)    |            |
| Number of intermittent fans                                                                  |        |        |        |        |         |           |         |        |        |                              | 0 * 10 =             | 0.0000 (7a)    |            |
| Number of passive vents                                                                      |        |        |        |        |         |           |         |        |        |                              | 0 * 10 =             | 0.0000 (7b)    |            |
| Number of flueless gas fires                                                                 |        |        |        |        |         |           |         |        |        |                              | 0 * 40 =             | 0.0000 (7c)    |            |
|                                                                                              |        |        |        |        |         |           |         |        |        |                              | Air changes per hour |                |            |
| Infiltration due to chimneys, flues and fans                                                 |        |        |        |        |         |           |         |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test                                                                                |        |        |        |        |         |           |         |        |        |                              | Yes                  |                |            |
| Measured/design AP50                                                                         |        |        |        |        |         |           |         |        |        |                              | 3.0000               |                |            |
| Infiltration rate                                                                            |        |        |        |        |         |           |         |        |        |                              | 0.1500 (18)          |                |            |
| Number of sides sheltered                                                                    |        |        |        |        |         |           |         |        |        |                              | 2 (19)               |                |            |
| Shelter factor                                                                               |        |        |        |        |         |           |         |        |        | (20) = 1 - [0.075 x (19)] =  |                      | 0.8500 (20)    |            |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |           |         |        |        | (21) = (18) x (20) =         |                      | 0.1275 (21)    |            |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul     | Aug    | Sep    | Oct                          | Nov                  | Dec            |            |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000    | 3.8000  | 3.7000 | 4.0000 | 4.3000                       | 4.5000               | 4.7000 (22)    |            |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500    | 0.9500  | 0.9250 | 1.0000 | 1.0750                       | 1.1250               | 1.1750 (22a)   |            |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371  | 0.1211    | 0.1211  | 0.1179 | 0.1275 | 0.1371                       | 0.1434               | 0.1498 (22b)   |            |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |           |         |        |        |                              |                      |                |            |
| If mechanical ventilation:                                                                   |        |        |        |        |         |           |         |        |        |                              |                      | 0.5000 (23a)   |            |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |           |         |        |        |                              |                      | 77.3500 (23c)  |            |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503  | 0.2344    | 0.2344  | 0.2312 | 0.2408 | 0.2503                       | 0.2567               | 0.2631 (25)    |            |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |               |                | 18.0000              | 0.9615           | 17.3077      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 36.8672       | 18.0000        | 18.8672              | 0.1600           | 3.0188       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 36.8672              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...(30) + (32) = |                  | 20.3264      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 68.8700              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 68.8700              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                      |                  |              |                   | 5.5301 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                      |                  |              |                   | 25.8565 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 15.6710       | 15.4899        | 15.3088              | 14.4033          | 14.2222      | 13.3167           | 13.3167       | 13.1356 | 13.6789 | 14.2222 | 14.5844 | 14.9466 (38) |
| Heat transfer coeff                                                 | 41.5276       | 41.3465        | 41.1654              | 40.2598          | 40.0787      | 39.1732           | 39.1732       | 38.9921 | 39.5354 | 40.0787 | 40.4409 | 40.8031 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                      |                  |              |                   |               |         |         |         |         | 40.2145 (39) |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.6030        | 0.6004         | 0.5977               | 0.5846           | 0.5819       | 0.5688            | 0.5688        | 0.5662  | 0.5741  | 0.5819  | 0.5872  | 0.5925 (40)  |
| HLP (average)                                                       |               |                |                      |                  |              |                   |               |         |         |         |         | 0.5839 (40)  |
| Days in month                                                       | 31            | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.2184 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 86.8865 (43)                      |
| Daily hot water use                      | Jan 95.5752 | Feb 92.0997 | Mar 88.6243 | Apr 85.1488 | May 81.6734 | Jun 78.1979 | Jul 78.1979 | Aug 81.6734 | Sep 85.1488 | Oct 88.6243 | Nov 92.0997 | Dec 95.5752 (44)                  |
| Energy conte                             | 141.7353    | 123.9626    | 127.9183    | 111.5222    | 107.0082    | 92.3400     | 85.5666     | 98.1889     | 99.3616     | 115.7963    | 126.4008    | 137.2630 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 21.2603     | 18.5944     | 19.1877     | 16.7283     | 16.0512     | 13.8510     | 12.8350     | 14.7283     | 14.9042     | 17.3695     | 18.9601     | 20.5895 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|-----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)                             |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)                             |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)                             |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)                             |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)                            |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)                            |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)                            |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (62)                           |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)                             |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |                                         | 0.0000 (63)    |
| Output from w/h                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (64)                           |                |
|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          | Total per year (kWh/year) = Sum (64)m = | 2017.9035 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 91.3484  | 81.1595  | 86.7543  | 79.8761  | 79.8017  | 73.4980  | 72.6723  | 76.8692                                   | 75.8327  | 82.7237  | 84.8232  | 89.8614 (65)                            |                |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8586   | 0.7768   | 0.6695   | 0.5267   | 0.3896   | 0.2670   | 0.1874   | 0.2071   | 0.3425   | 0.5765       | 0.7832   | 0.8765 (94)   |
| Useful gains         | 478.8236 | 524.6991 | 519.1291 | 454.1052 | 355.7605 | 238.7225 | 160.9971 | 168.0359 | 259.1352 | 380.2047     | 441.7635 | 458.6007 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 649.1146 | 633.5953 | 574.8842 | 472.3060 | 360.2585 | 239.3655 | 161.1026 | 168.1968 | 261.0475 | 401.5554     | 533.8952 | 639.7627 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 126.6965 | 73.1782  | 41.4818  | 13.1045  | 3.3465   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 15.8849      | 66.3348  | 134.7845 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 474.8119 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 6.8943 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 474.8119 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 498.5525 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2017.9035 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2118.7987 (310a) |
| Electricity used for heat distribution                                                  | 26.1735 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 115.5294 (330a)  |
| Total electricity for the above, kWh/year                                               | 115.5294 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 306.4556 (332)   |
| Total delivered energy for all uses                                                     | 3039.3362 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2755.1065          | 0.2160                        | 595.1030 (367)           |
| Electrical energy for heat distribution                                                    | 26.1735            | 0.5190                        | 13.5841 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 608.6871 (373)           |
| Space and water heating                                                                    |                    |                               | 608.6871 (376)           |
| Pumps and fans                                                                             | 115.5294           | 0.5190                        | 59.9598 (378)            |
| Energy for lighting                                                                        | 306.4556           | 0.5190                        | 159.0505 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 827.6973 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.0200 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.0200 ZC1 |
| Total Floor Area                                                                | TFA | 68.8700     |
| Assumed number of occupants                                                     | N   | 2.2184      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.7479 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5010 ZC3  |
| Total CO2 emissions                                                             |     | 31.2689 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 31.2689 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | Air changes per hour                    |
| Pressure test                                                             |                 |                      |       |       | 20.0000 / (5) = 0.1162 (8)              |
| Measured/design AP50                                                      |                 |                      |       |       | Yes                                     |
| Infiltration rate                                                         |                 |                      |       |       | 5.0000                                  |
| Number of sides sheltered                                                 |                 |                      |       |       | 0.3662 (18)                             |
|                                                                           |                 |                      |       |       | 2 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3112 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3968 | 0.3890 | 0.3813 | 0.3424 | 0.3346 | 0.2957 | 0.2957 | 0.2879 | 0.3112 | 0.3346 | 0.3501 | 0.3657 (22b) |
| Effective ac    | 0.5787 | 0.5757 | 0.5727 | 0.5586 | 0.5560 | 0.5437 | 0.5437 | 0.5414 | 0.5484 | 0.5560 | 0.5613 | 0.5669 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |               |                  |                              |                   |               |                            |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------|------------------------------|-------------------|---------------|----------------------------|---------|---------|---------|--------------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K |                            |         |         |         |              |
| TER Opening Type (Uw = 1.40)                                        |             |                | 17.2200       | 1.3258           | 22.8295                      |                   |               | (27)                       |         |         |         |              |
| External Wall 1                                                     | 36.8672     | 17.2200        | 19.6472       | 0.1800           | 3.5365                       |                   |               | (29a)                      |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 36.8672       |                  |                              |                   |               | (31)                       |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               |                  | (26)...(30) + (32) = 26.3660 |                   |               | (33)                       |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                  |                              |                   |               | 250.0000 (35)              |         |         |         |              |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |               |                  |                              |                   |               | 1.8434 (36)                |         |         |         |              |
| Total fabric heat loss                                              |             |                |               |                  |                              |                   |               | (33) + (36) = 28.2094 (37) |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                  |                              |                   |               |                            |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug                        | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 32.8825     | 32.7087        | 32.5385       | 31.7387          | 31.5891                      | 30.8925           | 30.8925       | 30.7635                    | 31.1608 | 31.5891 | 31.8918 | 32.2082 (38) |
| Heat transfer coeff                                                 | 61.0919     | 60.9182        | 60.7479       | 59.9481          | 59.7985                      | 59.1019           | 59.1019       | 58.9729                    | 59.3702 | 59.7985 | 60.1012 | 60.4176 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                  |                              |                   |               |                            |         |         |         | 59.9474 (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug                        | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.8871      | 0.8845         | 0.8821        | 0.8705           | 0.8683                       | 0.8582            | 0.8582        | 0.8563                     | 0.8621  | 0.8683  | 0.8727  | 0.8773 (40)  |
| HLP (average)                                                       |             |                |               |                  |                              |                   |               |                            |         |         |         | 0.8704 (40)  |
| Days in month                                                       | 31          | 28             | 31            | 30               | 31                           | 30                | 31            | 31                         | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.2184 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.8865 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 95.5752  | 92.0997  | 88.6243  | 85.1488  | 81.6734  | 78.1979 | 78.1979 | 81.6734 | 85.1488 | 88.6243            | 92.0997  | 95.5752 (44)   |
| Energy conte                                                | 141.7353 | 123.9626 | 127.9183 | 111.5222 | 107.0082 | 92.3400 | 85.5666 | 98.1889 | 99.3616 | 115.7963           | 126.4008 | 137.2630 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             | 21.2603  | 18.5944  | 19.1877  | 16.7283  | 16.0512  | 13.8510 | 12.8350 | 14.7283 | 14.9042 | 17.3695            | 18.9601  | 20.5895 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838                      | 144.4534    | 162.3912 | 171.4926 | 183.8579 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
|                                                                 | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838                      | 144.4534    | 162.3912 | 171.4926 | 183.8579 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1915.6811 (64) |
|                                                                 | 84.4029  | 74.8861  | 79.8087  | 73.1546  | 72.8562  | 66.7765  | 65.7268  | 69.9237                       | 69.1112     | 75.7782  | 78.1017  | 82.9159 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 17.3528  | 15.4126  | 12.5344  | 9.4893   | 7.0934   | 5.9885   | 6.4708   | 8.4110   | 11.2892  | 14.3343  | 16.7302  | 17.8351 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 194.6455 | 196.6653 | 191.5754 | 180.7397 | 167.0616 | 154.2061 | 145.6178 | 143.5980 | 148.6878 | 159.5235 | 173.2017 | 186.0572 (68) |
| Pumps, fans                                                                         | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 (71) |
| Total internal gains                                                                | 113.4448 | 111.4377 | 107.2698 | 101.6036 | 97.9250  | 92.7452  | 88.3425  | 93.9835  | 95.9878  | 101.8524 | 108.4746 | 111.4461 (72) |
|                                                                                     | 384.7187 | 382.7913 | 370.6553 | 351.1084 | 331.3556 | 312.2155 | 299.7068 | 305.2682 | 315.2406 | 334.9860 | 357.6822 | 374.6141 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|----------|---------------|
| Northeast   |          |          |          | 2.3000     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          |          | 7.9309 (75)   |
| Southeast   |          |          |          | 14.9200    | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          |          | 167.7705 (77) |
| -----       |          |          |          |            |                                |                                   |                                    |                              |          |          |          |               |
| Solar gains | 175.7014 | 301.9188 | 420.0958 | 532.2474   | 606.8667                       | 607.1870                          | 583.4334                           | 527.0442                     | 458.8226 | 335.5713 | 210.9295 | 150.0534 (83) |
| Total gains | 560.4201 | 684.7101 | 790.7511 | 883.3558   | 938.2223                       | 919.4024                          | 883.1402                           | 832.3124                     | 774.0631 | 670.5572 | 568.6118 | 524.6674 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
| tau                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| alpha                                                                       | 78.2860 | 78.5093 | 78.7293 | 79.7797 | 79.9793 | 80.9219 | 80.9219 | 81.0989 | 80.5562                   | 79.9793 | 79.5765 | 79.1596      |
| util living area                                                            | 6.2191  | 6.2340  | 6.2486  | 6.3186  | 6.3320  | 6.3948  | 6.3948  | 6.4066  | 6.3704                    | 6.3320  | 6.3051  | 6.2773       |
|                                                                             | 0.9890  | 0.9653  | 0.9039  | 0.7658  | 0.5837  | 0.4106  | 0.2944  | 0.3258  | 0.5249                    | 0.8290  | 0.9700  | 0.9923 (86)  |
| MIT                                                                         | 20.3326 | 20.5417 | 20.7619 | 20.9297 | 20.9879 | 20.9989 | 20.9999 | 20.9998 | 20.9951                   | 20.9051 | 20.5923 | 20.2905 (87) |
| Th 2                                                                        | 20.1785 | 20.1807 | 20.1828 | 20.1927 | 20.1945 | 20.2032 | 20.2032 | 20.2048 | 20.1999                   | 20.1945 | 20.1908 | 20.1869 (88) |
| util rest of house                                                          | 0.9858  | 0.9563  | 0.8826  | 0.7275  | 0.5362  | 0.3599  | 0.2411  | 0.2695  | 0.4659                    | 0.7881  | 0.9605  | 0.9900 (89)  |
| MIT 2                                                                       | 19.3025 | 19.6012 | 19.9029 | 20.1204 | 20.1844 | 20.2026 | 20.2032 | 20.2047 | 20.1966                   | 20.0992 | 19.6847 | 19.2485 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4703 (91)  |
| MIT                                                                         | 19.7870 | 20.0435 | 20.3069 | 20.5010 | 20.5623 | 20.5771 | 20.5779 | 20.5787 | 20.5722                   | 20.4782 | 20.1115 | 19.7386 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.7870 | 20.0435 | 20.3069 | 20.5010 | 20.5623 | 20.5771 | 20.5779 | 20.5787 | 20.5722                   | 20.4782 | 20.1115 | 19.7386 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9839   | 0.9545   | 0.8861   | 0.7426   | 0.5581   | 0.3837   | 0.2662   | 0.2960   | 0.4935   | 0.8033       | 0.9595   | 0.9884 (94)    |
| Ext temp.            | 551.4168 | 653.5872 | 700.6752 | 655.9553 | 523.6578 | 352.7766 | 235.0633 | 246.3563 | 382.0076 | 538.6344     | 545.5577 | 518.5781 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 946.1280 | 922.5151 | 838.7399 | 695.4604 | 529.9491 | 353.2568 | 235.0998 | 246.4275 | 384.2545 | 590.7022     | 782.0083 | 938.8043 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 293.6651 | 180.7195 | 102.7201 | 28.4437  | 4.6808   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 38.7385      | 170.2444 | 312.6483 (98)  |
|                      |          |          |          |          |          |          |          |          |          |              |          | 1131.8605 (98) |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 16.4347 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1210.5460 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 293.6651 | 180.7195 | 102.7201 | 28.4437  | 4.6808   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 38.7385  | 170.2444 | 312.6483  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 314.0804 | 193.2829 | 109.8611 | 30.4210  | 5.0062   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 41.4315  | 182.0796 | 334.3833  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838 | 144.4534 | 162.3912 | 171.4926 | 183.8579  | (64)            |
| Efficiency of water heater (217)m                                     | 85.9946  | 85.0399  | 83.4560  | 81.2770  | 80.0800  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.6596  | 84.7944  | 86.2190   | (217)           |
| Fuel for water heating, kWh/month                                     | 219.0022 | 195.2592 | 209.1081 | 192.6918 | 191.8122 | 172.2203 | 165.6159 | 181.4333 | 181.0193 | 198.8637 | 202.2452 | 213.2452  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2322.5164 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1210.5460 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 306.4556  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3914.5179 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1210.5460          | 0.2160                        | 261.4779 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2322.5164          | 0.2160                        | 501.6635 (264)           |
| Space and water heating                                                                           |                    |                               | 763.1415 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 306.4556           | 0.5190                        | 159.0505 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 961.1169 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.0809 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3094 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5652 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.0809 * 1.00) + 2.3094 + 0.5652, rounded to 2 d.p. |                    |                               | 13.9600 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000510                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.08_1B |                |            |
| Property                           | A_2_14.08_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 83 B                                | DER           | 17.15        | TER            | 15.63      |
| Environmental                      | 88 B                                | % DER<TER     | -9.70        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.82                                | DFEE          | 42.16        | TFEE           | 29.72      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -41.86       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 53 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.63 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 17.15 kgCO<sub>2</sub>/m<sup>2</sup>Fail  
Excess emissions =1.52 kgCO<sub>2</sub>/m<sup>2</sup> (9.7%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)29.7 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)42.2 kWh/m<sup>2</sup>/yrFail  
Excess energy =12.5 kWh/m<sup>2</sup>/yr (42.1%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default y-value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South East: | 12.00 m <sup>2</sup> , No overhang |
| Windows facing South West: | 13.20 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4500 (1b)              | x 2.5000 (2b)                   | = 133.6250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4500                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6250 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    |        | secondary |        |        | other  |        | total    | m3 per hour                 |  |               |  |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|--------|-----------|--------|--------|--------|--------|----------|-----------------------------|--|---------------|--|
|                                                                                              |        |        |        |        | heating | +      | heating   | +      |        | =      |        | 0 * 40 = | 0.0000 (6a)                 |  |               |  |
|                                                                                              |        |        |        |        | 0       | +      | 0         | +      | 0      | =      |        | 0 * 20 = | 0.0000 (6b)                 |  |               |  |
|                                                                                              |        |        |        |        | 0       | +      | 0         | +      | 0      | =      |        | 0 * 10 = | 0.0000 (7a)                 |  |               |  |
| Number of intermittent fans                                                                  |        |        |        |        |         |        |           |        |        |        |        | 0 * 10 = | 0.0000 (7b)                 |  |               |  |
| Number of passive vents                                                                      |        |        |        |        |         |        |           |        |        |        |        | 0 * 10 = | 0.0000 (7c)                 |  |               |  |
| Number of flueless gas fires                                                                 |        |        |        |        |         |        |           |        |        |        |        | 0 * 40 = | 0.0000 (7c)                 |  |               |  |
|                                                                                              |        |        |        |        |         |        |           |        |        |        |        |          | Air changes per hour        |  |               |  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                    |        |        |        |        |         |        |           |        |        |        |        |          | 0.0000 / (5) =              |  | 0.0000 (8)    |  |
| Pressure test                                                                                |        |        |        |        |         |        |           |        |        |        |        |          | Yes                         |  |               |  |
| Measured/design AP50                                                                         |        |        |        |        |         |        |           |        |        |        |        |          | 3.0000                      |  |               |  |
| Infiltration rate                                                                            |        |        |        |        |         |        |           |        |        |        |        |          | 0.1500                      |  | (18)          |  |
| Number of sides sheltered                                                                    |        |        |        |        |         |        |           |        |        |        |        |          | 2                           |  | (19)          |  |
| Shelter factor                                                                               |        |        |        |        |         |        |           |        |        |        |        |          | (20) = 1 - [0.075 x (19)] = |  | 0.8500 (20)   |  |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |        |           |        |        |        |        |          | (21) = (18) x (20) =        |  | 0.1275 (21)   |  |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun    | Jul       | Aug    | Sep    | Oct    | Nov    | Dec      |                             |  |               |  |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000 | 3.8000    | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000   | (22)                        |  |               |  |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500 | 0.9500    | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750   | (22a)                       |  |               |  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371  | 0.1211 | 0.1211    | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498   | (22b)                       |  |               |  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |        |           |        |        |        |        |          |                             |  |               |  |
| If mechanical ventilation:                                                                   |        |        |        |        |         |        |           |        |        |        |        |          |                             |  | 0.5000 (23a)  |  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |        |           |        |        |        |        |          |                             |  | 77.3500 (23c) |  |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503  | 0.2344 | 0.2344    | 0.2312 | 0.2408 | 0.2503 | 0.2567 | 0.2631   | (25)                        |  |               |  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|---------------|----------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 25.2000       | 1.3258               | 33.4091      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 40.0425       | 25.2000        | 14.8425       | 0.1600               | 2.3748       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 40.0425       |                      |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                |               | (26)...(30) + (32) = | 35.7839      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 53.4500       |                      |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 53.4500       |                      |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |               |                      |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |               |                      |              |                   | 6.0064 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |               |                      |              |                   | 41.7903 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |               |                      |              |                   |               |         |         |         |         |              |
| (38)m                                                               | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 12.1623       | 12.0217        | 11.8812       | 11.1784              | 11.0378      | 10.3351           | 10.3351       | 10.1945 | 10.6162 | 11.0378 | 11.3190 | 11.6001 (38) |
|                                                                     | 53.9526       | 53.8120        | 53.6714       | 52.9687              | 52.8281      | 52.1253           | 52.1253       | 51.9848 | 52.4064 | 52.8281 | 53.1092 | 53.3903 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |               |                      |              |                   |               |         |         |         |         | 52.9335 (39) |
|                                                                     | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 1.0094        | 1.0068         | 1.0041        | 0.9910               | 0.9884       | 0.9752            | 0.9752        | 0.9726  | 0.9805  | 0.9884  | 0.9936  | 0.9989 (40)  |
| HLP (average)                                                       |               |                |               |                      |              |                   |               |         |         |         |         | 0.9903 (40)  |
| Days in month                                                       | 31            | 28             | 31            | 30                   | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.7918 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 76.7557 (43)                      |
| Daily hot water use                      | Jan 84.4313 | Feb 81.3610 | Mar 78.2908 | Apr 75.2206 | May 72.1503 | Jun 69.0801 | Jul 69.0801 | Aug 72.1503 | Sep 75.2206 | Oct 78.2908 | Nov 81.3610 | Dec 84.4313 (44)                  |
| Energy conte                             | 125.2091    | 109.5087    | 113.0032    | 98.5189     | 94.5312     | 81.5733     | 75.5896     | 86.7402     | 87.7761     | 102.2946    | 111.6626    | 121.2583 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1207.6658 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             | 18.1888 (46)                      |
| Water storage loss:                      | Jan 18.7814 | Feb 16.4263 | Mar 16.9505 | Apr 14.7778 | May 14.1797 | Jun 12.2360 | Jul 11.3384 | Aug 13.0110 | Sep 13.1664 | Oct 15.3442 | Nov 16.7494 | Dec 18.1888 (46)                  |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)    |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)   |
| Primary loss                                                    |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 180.4859 | 159.4361 | 168.2800 | 152.0126 | 149.8080 | 135.0669 | 130.8664 | 142.0170 | 141.2698 | 157.5714 | 165.1563 | 176.5351 (62)  |
| Solar input                                                     |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 180.4859 | 159.4361 | 168.2800 | 152.0126 | 149.8080 | 135.0669 | 130.8664 | 142.0170 | 141.2698 | 157.5714 | 165.1563 | 176.5351 (64)  |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 1858.5056 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 85.8535  | 76.3536  | 81.7950  | 75.5525  | 75.6531  | 69.9181  | 69.3550  | 73.0626  | 71.9805  | 78.2344  | 79.9228  | 84.5398 (65)   |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9238  | 12.3670  | 10.0575  | 7.6142   | 5.6917   | 4.8052   | 5.1922   | 6.7490   | 9.0584   | 11.5018  | 13.4243  | 14.3108 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.1827 | 157.8033 | 153.7193 | 145.0247 | 134.0495 | 123.7343 | 116.8431 | 115.2224 | 119.3065 | 128.0010 | 138.9763 | 149.2915 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 (71) |
| Water heating gains (Table 5)                                                       | 115.3945 | 113.6214 | 109.9395 | 104.9340 | 101.6842 | 97.1084  | 93.2191  | 98.2024  | 99.9729  | 105.1538 | 111.0038 | 113.6288 (72) |
| Total internal gains                                                                | 335.3782 | 333.6690 | 323.5936 | 307.4502 | 291.3027 | 275.5251 | 265.1316 | 270.0510 | 278.2151 | 294.5338 | 313.2816 | 327.1083 (73) |

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Southeast | 12.0000    | 36.7938                        | 0.3000                            | 0.8000                             | 0.7700                       | 73.4346 (77) |
| Southwest | 13.2000    | 36.7938                        | 0.3000                            | 0.8000                             | 0.7700                       | 80.7781 (79) |

|                        |         |         |         |         |         |         |         |         |         |                           |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| MIT                    | 19.4001 | 19.7531 | 20.1503 | 20.5416 | 20.8003 | 20.9382 | 20.9811 | 20.9755 | 20.8896 | 20.5420                   | 19.9137 | 19.3291 (87) |
| Th 2                   | 20.0755 | 20.0777 | 20.0799 | 20.0908 | 20.0930 | 20.1040 | 20.1040 | 20.1062 | 20.0996 | 20.0930                   | 20.0886 | 20.0843 (88) |
| util rest of house     | 0.8993  | 0.8424  | 0.7634  | 0.6476  | 0.5088  | 0.3586  | 0.2428  | 0.2677  | 0.4412  | 0.6824                    | 0.8473  | 0.9122 (89)  |
| MIT 2                  | 17.9613 | 18.4583 | 19.0103 | 19.5457 | 19.8783 | 20.0494 | 20.0917 | 20.0894 | 19.9957 | 19.5621                   | 18.7020 | 17.8664 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.4526 (91)  |
| MIT                    | 18.6125 | 19.0443 | 19.5262 | 19.9964 | 20.2956 | 20.4516 | 20.4942 | 20.4904 | 20.4003 | 20.0056                   | 19.2504 | 18.5284 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |         |                           |         | 0.0000       |
| adjusted MIT           | 18.6125 | 19.0443 | 19.5262 | 19.9964 | 20.2956 | 20.4516 | 20.4942 | 20.4904 | 20.4003 | 20.0056                   | 19.2504 | 18.5284 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | 0.8782   | 0.8219   | 0.7484   | 0.6442   | 0.5184   | 0.3790   | 0.2687   | 0.2941   | 0.4597   | 0.6787   | 0.8282   | 0.8918 (94)               |
| Useful gains         | 429.9582 | 490.1507 | 511.1887 | 484.9262 | 409.5627 | 292.1253 | 199.5295 | 208.0677 | 306.8153 | 396.9478 | 412.4266 | 409.3899 (95)             |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Heat loss rate W     | 772.1939 | 761.1319 | 699.1349 | 587.7622 | 454.0890 | 305.0190 | 202.9866 | 212.6399 | 330.1754 | 496.8775 | 645.2979 | 764.9971 (97)             |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating kWh    | 254.6234 | 182.0994 | 139.8320 | 74.0419  | 33.1276  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 74.3477  | 167.6673 | 264.5717 (98)             |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1190.3110 (98)            |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 22.2696 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1190.3110 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1249.8265 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1858.5056 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1951.4309 (310a) |
| Electricity used for heat distribution                                                  | 32.0126 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.5868 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.5868 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 245.8986 (332)   |
| Total delivered energy for all uses                                                     | 3532.7428 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3369.7446          | 0.2160                        | 727.8648 (367)           |
| Electrical energy for heat distribution                                                    | 32.0126            | 0.5190                        | 16.6145 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 744.4794 (373)           |
| Space and water heating                                                                    |                    |                               | 744.4794 (376)           |
| Pumps and fans                                                                             | 85.5868            | 0.5190                        | 44.4196 (378)            |
| Energy for lighting                                                                        | 245.8986           | 0.5190                        | 127.6214 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 916.5203 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.1500 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |  |     |             |
|---------------------------------------------------------------------------------|--|-----|-------------|
| DER                                                                             |  |     | 17.1500 ZC1 |
| Total Floor Area                                                                |  | TFA | 53.4500     |
| Assumed number of occupants                                                     |  | N   | 1.7918      |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |  |     | 17.3154 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  |     | 3.0309 ZC3  |
| Total CO2 emissions                                                             |  |     | 37.4963 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |  |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |  |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |  |     | 37.4963 ZC8 |



SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4500 (1b)              | x 2.5000 (2b)                   | = 133.6250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4500                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6250 (5)              |

|                                                      | main<br>heating              |   | secondary<br>heating |   | other |   | total                       | m3 per hour          |      |
|------------------------------------------------------|------------------------------|---|----------------------|---|-------|---|-----------------------------|----------------------|------|
| Number of chimneys                                   | 0                            | + | 0                    | + | 0     | = | 0 * 40 =                    | 0.0000               | (6a) |
| Number of open flues                                 | 0                            | + | 0                    | + | 0     | = | 0 * 20 =                    | 0.0000               | (6b) |
| Number of intermittent fans                          |                              |   |                      |   |       |   | 2 * 10 =                    | 20.0000              | (7a) |
| Number of passive vents                              |                              |   |                      |   |       |   | 0 * 10 =                    | 0.0000               | (7b) |
| Number of flueless gas fires                         |                              |   |                      |   |       |   | 0 * 40 =                    | 0.0000               | (7c) |
|                                                      |                              |   |                      |   |       |   |                             | Air changes per hour |      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |   |                      |   |       |   | 20.0000 / (5) =             | 0.1497               | (8)  |
| Pressure test                                        |                              |   |                      |   |       |   | Yes                         |                      |      |
| Measured/design AP50                                 |                              |   |                      |   |       |   |                             | 5.0000               |      |
| Infiltration rate                                    |                              |   |                      |   |       |   |                             | 0.3997               | (18) |
| Number of sides sheltered                            |                              |   |                      |   |       |   |                             | 2                    | (19) |
| Shelter factor                                       |                              |   |                      |   |       |   | (20) = 1 - [0.075 x (19)] = | 0.8500               | (20) |
| Infiltration rate adjusted to include shelter factor |                              |   |                      |   |       |   | (21) = (18) x (20) =        | 0.3397               | (21) |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4331 | 0.4247 | 0.4162 | 0.3737 | 0.3652 | 0.3227 | 0.3227 | 0.3142 | 0.3397 | 0.3652 | 0.3822 | 0.3992 (22b) |
| Effective ac    | 0.5938 | 0.5902 | 0.5866 | 0.5698 | 0.5667 | 0.5521 | 0.5521 | 0.5494 | 0.5577 | 0.5667 | 0.5730 | 0.5797 (25)  |

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| TER Opening Type (Uw = 1.40)                                        |             |                | 13.3700              | 1.3258           | 17.7254      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 40.0425     | 13.3700        | 26.6725              | 0.1800           | 4.8011       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 40.0425              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  |              | 22.5264           | (33)          |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   | 250.0000 (35) |         |         |         |         |              |
| Thermal Bridges (User defined value 0.050 * total exposed area)     |             |                |                      |                  |              |                   | 2.0021 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 24.5286 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 26.1847     | 26.0241        | 25.8666              | 25.1271          | 24.9887      | 24.3446           | 24.3446       | 24.2253 | 24.5927 | 24.9887 | 25.2686 | 25.5613 (38) |
| Heat transfer coeff                                                 | 50.7132     | 50.5526        | 50.3952              | 49.6556          | 49.5173      | 48.8732           | 48.8732       | 48.7539 | 49.1213 | 49.5173 | 49.7972 | 50.0898 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |         |         |         |         | 49.6550 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.9488      | 0.9458         | 0.9428               | 0.9290           | 0.9264       | 0.9144            | 0.9144        | 0.9121  | 0.9190  | 0.9264  | 0.9317  | 0.9371 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |         |         |         |         | 0.9290 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

|                                                             |                    |          |          |         |         |         |         |         |         |          |          |                |
|-------------------------------------------------------------|--------------------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|----------------|
| Assumed occupancy                                           |                    |          |          |         |         |         |         |         |         |          |          | 1.7918 (42)    |
| Average daily hot water use (litres/day)                    |                    |          |          |         |         |         |         |         |         |          |          | 76.7557 (43)   |
|                                                             | Jan                | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec            |
| Daily hot water use                                         |                    |          |          |         |         |         |         |         |         |          |          |                |
|                                                             | 84.4313            | 81.3610  | 78.2908  | 75.2206 | 72.1503 | 69.0801 | 69.0801 | 72.1503 | 75.2206 | 78.2908  | 81.3610  | 84.4313 (44)   |
| Energy content (annual)                                     | 125.2091           | 109.5087 | 113.0032 | 98.5189 | 94.5312 | 81.5733 | 75.5896 | 86.7402 | 87.7761 | 102.2946 | 111.6626 | 121.2583 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                      | Total = Sum(45)m = |          |          |         |         |         |         |         |         |          |          | 1207.6658 (45) |
|                                                             | 18.7814            | 16.4263  | 16.9505  | 14.7778 | 14.1797 | 12.2360 | 11.3384 | 13.0110 | 13.1664 | 15.3442  | 16.7494  | 18.1888 (46)   |
| Water storage loss:                                         |                    |          |          |         |         |         |         |         |         |          |          |                |
| Store volume                                                |                    |          |          |         |         |         |         |         |         |          |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |                    |          |          |         |         |         |         |         |         |          |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |                    |          |          |         |         |         |         |         |         |          |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |                    |          |          |         |         |         |         |         |         |          |          | 0.7527 (55)    |
| Total storage loss                                          |                    |          |          |         |         |         |         |         |         |          |          |                |
|                                                             | 23.3325            | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325  | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |                    |          |          |         |         |         |         |         |         |          |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                                   | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.8040 | 151.5944 | 159.5981 | 143.6107 | 141.1261 | 126.6651 | 122.1845 | 133.3351                                  | 132.8680 | 148.8895 | 156.7544 | 167.8532 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.8040 | 151.5944 | 159.5981 | 143.6107 | 141.1261 | 126.6651 | 122.1845 | 133.3351                                  | 132.8680 | 148.8895 | 156.7544 | 167.8532 (64)  |
|                                                                 | 78.9080  | 70.0802  | 74.8495  | 68.8310  | 68.7076  | 63.1966  | 62.4095  | 66.1170                                   | 65.2590  | 71.2889  | 73.2013  | 77.5943 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          | 1756.2832 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9238  | 12.3670  | 10.0575  | 7.6142   | 5.6917   | 4.8052   | 5.1922   | 6.7490   | 9.0584   | 11.5018  | 13.4243  | 14.3108  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.1827 | 157.8033 | 153.7193 | 145.0247 | 134.0495 | 123.7343 | 116.8431 | 115.2224 | 119.3065 | 128.0010 | 138.9763 | 149.2915 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | (71) |
| Water heating gains (Table 5)                                                       | 106.0591 | 104.2860 | 100.6041 | 95.5986  | 92.3489  | 87.7730  | 83.8837  | 88.8670  | 90.6376  | 95.8184  | 101.6684 | 104.2934 | (72) |
| Total internal gains                                                                | 329.0428 | 327.3336 | 317.2582 | 301.1148 | 284.9673 | 269.1897 | 258.7962 | 263.7156 | 271.8797 | 288.1984 | 306.9462 | 320.7730 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>g<br>or Table 6b | Specific data<br>FF<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |      |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|------|
| Southeast   |          |          |          |          | 6.3700     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 71.6286 (77) |          |          |      |
| Southwest   |          |          |          |          | 7.0000     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 78.7127 (79) |          |          |      |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |              |          |          |      |
| Solar gains | 150.3413 | 256.0868 | 350.3892 | 434.1492 | 486.2832   | 482.7667                       | 465.4386                          | 426.5443                           | 379.3974                     | 283.0305     | 180.0742 | 128.6608 | (83) |
| Total gains | 479.3841 | 583.4205 | 667.6473 | 735.2640 | 771.2505   | 751.9564                       | 724.2348                          | 690.2599                           | 651.2771                     | 571.2289     | 487.0204 | 449.4338 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 73.1921 | 73.4246 | 73.6540 | 74.7509 | 74.9598 | 75.9477 | 75.9477 | 76.1335 | 75.5641 | 74.9598 | 74.5385 | 74.1030 |              |
| alpha                                                                       | 5.8795  | 5.8950  | 5.9103  | 5.9834  | 5.9973  | 6.0632  | 6.0632  | 6.0756  | 6.0376  | 5.9973  | 5.9692  | 5.9402  |              |
| util living area                                                            | 0.9844  | 0.9558  | 0.8909  | 0.7581  | 0.5859  | 0.4148  | 0.2968  | 0.3247  | 0.5155  | 0.8091  | 0.9602  | 0.9886  | (86)         |
| MIT                                                                         | 20.3160 | 20.5323 | 20.7518 | 20.9205 | 20.9841 | 20.9984 | 20.9998 | 20.9997 | 20.9942 | 20.9033 | 20.5891 | 20.2740 | (87)         |
| Th 2                                                                        | 20.1262 | 20.1288 | 20.1312 | 20.1429 | 20.1451 | 20.1553 | 20.1553 | 20.1572 | 20.1514 | 20.1451 | 20.1407 | 20.1361 | (88)         |
| util rest of house                                                          | 0.9800  | 0.9446  | 0.8672  | 0.7181  | 0.5358  | 0.3606  | 0.2399  | 0.2653  | 0.4542  | 0.7650  | 0.9481  | 0.9853  | (89)         |
| MIT 2                                                                       | 19.2371 | 19.5440 | 19.8425 | 20.0617 | 20.1318 | 20.1543 | 20.1552 | 20.1571 | 20.1475 | 20.0494 | 19.6378 | 19.1845 | (90)         |
| Living area fraction                                                        | 19.7254 | 19.9913 | 20.2540 | 20.4504 | 20.5176 | 20.5363 | 20.5375 | 20.5384 | 20.5307 | 20.4359 | 20.0684 | 19.6776 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.7254 | 19.9913 | 20.2540 | 20.4504 | 20.5176 | 20.5363 | 20.5375 | 20.5384 | 20.5307 | 20.4359 | 20.0684 | 19.6776 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec      |       |
| Useful gains         | 468.5844 | 549.9096 | 581.3929 | 538.8889 | 430.2575 | 289.5723 | 192.3912 | 201.6832 | 313.8104 | 446.0083     | 461.1853 | 441.8543 | (94)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000   | (96)  |
| Heat loss rate W     | 782.2721 | 762.9033 | 693.1359 | 573.5404 | 436.6222 | 290.1264 | 192.4369 | 201.7644 | 315.8841 | 487.0453     | 645.7874 | 775.2692 | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000   | (97a) |
| Space heating kWh    | 233.3837 | 143.1318 | 83.1368  | 24.9491  | 4.7354   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 30.5315      | 132.9135 | 248.0607 | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 900.8424 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 16.8539  | (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |          |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)   |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)   |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 963.4679 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                |
| Space heating requirement                                             | 233.3837 | 143.1318 | 83.1368  | 24.9491  | 4.7354   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 30.5315  | 132.9135 | 248.0607  | (98)           |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)          |
| Space heating fuel (main heating system)                              | 249.6082 | 153.0821 | 88.9164  | 26.6836  | 5.0646   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 32.6540  | 142.1534 | 265.3055  | (211)          |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)          |
| Water heating requirement                                             | 171.8040 | 151.5944 | 159.5981 | 143.6107 | 141.1261 | 126.6651 | 122.1845 | 133.3351 | 132.8680 | 148.8895 | 156.7544 | 167.8532  | (64)           |
| Efficiency of water heater (217)m                                     | 85.6315  | 84.6611  | 83.1678  | 81.2214  | 80.1075  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.4385  | 84.3775  | 85.8541   | (217)          |
| Fuel for water heating, kWh/month                                     | 200.6317 | 179.0602 | 191.8988 | 176.8140 | 176.1710 | 158.7282 | 153.1134 | 167.0866 | 166.5012 | 182.8246 | 185.7775 | 195.5098  | (219)          |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2134.1169 | (219)          |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 963.4679  | (211)          |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)          |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)         |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)         |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)          |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 245.8986  | (232)          |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3418.4834 | (238)          |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 963.4679           | 0.2160                        | 208.1091 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2134.1169          | 0.2160                        | 460.9693 (264)           |
| Space and water heating                                                                           |                    |                               | 669.0783 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 245.8986           | 0.5190                        | 127.6214 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 835.6247 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.5178 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3877 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7283 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.5178 * 1.00) + 2.3877 + 0.7283, rounded to 2 d.p. |                    |                               | 15.6300 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000554                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.08_1B |                |            |
| Property                           | A_2_14.08_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.31        | TER            | 15.63      |
| Environmental                      | 90 B                                | % DER<TER     | 8.47         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.70                                | DFEE          | 31.16        | TFEE           | 29.72      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -4.85        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 53 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.63 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.31 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)29.7 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)31.2 kWh/m<sup>2</sup>/yrFail  
Excess energy =1.5 kWh/m<sup>2</sup>/yr (5.1%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

|                           |      |
|---------------------------|------|
| Secondary heating system: | None |
|---------------------------|------|

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                    |      |
|-----------------------------------|------------------------------------|------|
| Overheating risk (Thames Valley): | High                               | Fail |
| Based on:                         |                                    |      |
| Overshading:                      | Average                            |      |
| Windows facing South East:        | 12.00 m <sup>2</sup> , No overhang |      |
| Windows facing South West:        | 13.20 m <sup>2</sup> , No overhang |      |
| Air change rate:                  | 2.00 ach                           |      |
| Blinds/curtains:                  | None                               |      |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4500 (1b)              | x 2.5000 (2b)                   | = 133.6250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4500                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6250 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    | secondary | other   |        |        | total                        | m3 per hour          |                |            |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|-----------|---------|--------|--------|------------------------------|----------------------|----------------|------------|
|                                                                                              |        |        |        |        | heating |           | heating |        |        |                              |                      |                |            |
| Number of chimneys                                                                           |        |        |        |        | 0       | +         | 0       | +      | 0      | =                            | 0 * 40 =             | 0.0000 (6a)    |            |
| Number of open flues                                                                         |        |        |        |        | 0       | +         | 0       | +      | 0      | =                            | 0 * 20 =             | 0.0000 (6b)    |            |
| Number of intermittent fans                                                                  |        |        |        |        |         |           |         |        |        |                              | 0 * 10 =             | 0.0000 (7a)    |            |
| Number of passive vents                                                                      |        |        |        |        |         |           |         |        |        |                              | 0 * 10 =             | 0.0000 (7b)    |            |
| Number of flueless gas fires                                                                 |        |        |        |        |         |           |         |        |        |                              | 0 * 40 =             | 0.0000 (7c)    |            |
|                                                                                              |        |        |        |        |         |           |         |        |        |                              | Air changes per hour |                |            |
| Infiltration due to chimneys, flues and fans                                                 |        |        |        |        |         |           |         |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test                                                                                |        |        |        |        |         |           |         |        |        |                              | Yes                  |                |            |
| Measured/design AP50                                                                         |        |        |        |        |         |           |         |        |        |                              | 3.0000               |                |            |
| Infiltration rate                                                                            |        |        |        |        |         |           |         |        |        |                              | 0.1500 (18)          |                |            |
| Number of sides sheltered                                                                    |        |        |        |        |         |           |         |        |        |                              | 2 (19)               |                |            |
| Shelter factor                                                                               |        |        |        |        |         |           |         |        |        | (20) = 1 - [0.075 x (19)] =  |                      | 0.8500 (20)    |            |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |           |         |        |        | (21) = (18) x (20) =         |                      | 0.1275 (21)    |            |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul     | Aug    | Sep    | Oct                          | Nov                  | Dec            |            |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000    | 3.8000  | 3.7000 | 4.0000 | 4.3000                       | 4.5000               | 4.7000 (22)    |            |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500    | 0.9500  | 0.9250 | 1.0000 | 1.0750                       | 1.1250               | 1.1750 (22a)   |            |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371  | 0.1211    | 0.1211  | 0.1179 | 0.1275 | 0.1371                       | 0.1434               | 0.1498 (22b)   |            |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |           |         |        |        |                              |                      |                |            |
| If mechanical ventilation:                                                                   |        |        |        |        |         |           |         |        |        |                              |                      | 0.5000 (23a)   |            |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |           |         |        |        |                              |                      | 77.3500 (23c)  |            |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503  | 0.2344    | 0.2344  | 0.2312 | 0.2408 | 0.2503                       | 0.2567               | 0.2631 (25)    |            |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|---------------|----------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |               |                | 25.2000       | 0.9615               | 24.2308      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 40.0425       | 25.2000        | 14.8425       | 0.1600               | 2.3748       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 40.0425       |                      |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                |               | (26)...(30) + (32) = | 26.6056      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 53.4500       |                      |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 53.4500       |                      |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |               |                      |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |               |                      |              |                   | 6.0064 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |               |                      |              |                   | 32.6119 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |               |                      |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 12.1623       | 12.0217        | 11.8812       | 11.1784              | 11.0378      | 10.3351           | 10.3351       | 10.1945 | 10.6162 | 11.0378 | 11.3190 | 11.6001 (38) |
| Heat transfer coeff                                                 | 44.7742       | 44.6337        | 44.4931       | 43.7903              | 43.6498      | 42.9470           | 42.9470       | 42.8064 | 43.2281 | 43.6498 | 43.9309 | 44.2120 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |               |                      |              |                   |               |         |         |         |         | 43.7552 (39) |
|                                                                     | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.8377        | 0.8351         | 0.8324        | 0.8193               | 0.8166       | 0.8035            | 0.8035        | 0.8009  | 0.8088  | 0.8166  | 0.8219  | 0.8272 (40)  |
| HLP (average)                                                       |               |                |               |                      |              |                   |               |         |         |         |         | 0.8186 (40)  |
| Days in month                                                       | 31            | 28             | 31            | 30                   | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.7918 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 76.7557 (43)                      |
| Daily hot water use                      | Jan 84.4313 | Feb 81.3610 | Mar 78.2908 | Apr 75.2206 | May 72.1503 | Jun 69.0801 | Jul 69.0801 | Aug 72.1503 | Sep 75.2206 | Oct 78.2908 | Nov 81.3610 | Dec 84.4313 (44)                  |
| Energy conte                             | 125.2091    | 109.5087    | 113.0032    | 98.5189     | 94.5312     | 81.5733     | 75.5896     | 86.7402     | 87.7761     | 102.2946    | 111.6626    | 121.2583 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1207.6658 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 18.7814     | 16.4263     | 16.9505     | 14.7778     | 14.1797     | 12.2360     | 11.3384     | 13.0110     | 13.1664     | 15.3442     | 16.7494     | 18.1888 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             |                                   |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |             |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|-------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |             |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51) |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52) |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53) |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55) |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |             |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144     | (56)           |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |             |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144     | (57)           |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624     | (59)           |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |             |                |
|                                                                 | 180.4859 | 159.4361 | 168.2800 | 152.0126 | 149.8080 | 135.0669 | 130.8664 | 142.0170                                  | 141.2698 | 157.5714 | 165.1563 | 176.5351    | (62)           |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000      | (63)           |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |             | 0.0000 (63)    |
| Output from w/h                                                 | 180.4859 | 159.4361 | 168.2800 | 152.0126 | 149.8080 | 135.0669 | 130.8664 | 142.0170                                  | 141.2698 | 157.5714 | 165.1563 | 176.5351    | (64)           |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          |             | 1858.5056 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |             |                |
|                                                                 | 85.8535  | 76.3536  | 81.7950  | 75.5525  | 75.6531  | 69.9181  | 69.3550  | 73.0626                                   | 71.9805  | 78.2344  | 79.9228  | 84.5398     | (65)           |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8121   | 0.7069   | 0.5908   | 0.4580   | 0.3370   | 0.2319   | 0.1611   | 0.1789   | 0.2976   | 0.5132       | 0.7281   | 0.8356 (94)   |
| Useful gains         | 481.0756 | 545.3151 | 545.0594 | 480.7351 | 378.3160 | 255.3022 | 170.9244 | 178.7980 | 275.8391 | 399.4620     | 452.2215 | 457.1384 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 679.8108 | 670.3833 | 611.4788 | 506.1808 | 386.1460 | 256.9120 | 171.2713 | 179.2953 | 279.6522 | 429.3848     | 565.8348 | 671.4672 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 147.8590 | 84.0458  | 49.4161  | 18.3209  | 5.8255   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 22.2626      | 81.8016  | 159.4606 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 568.9921 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 10.6453 (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 568.9921 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 597.4417 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1858.5056 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1951.4309 (310a) |
| Electricity used for heat distribution                                                  | 25.4887 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.5868 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.5868 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 245.8986 (332)   |
| Total delivered energy for all uses                                                     | 2880.3580 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2683.0237          | 0.2160                        | 579.5331 (367)           |
| Electrical energy for heat distribution                                                    | 25.4887            | 0.5190                        | 13.2286 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 592.7618 (373)           |
| Space and water heating                                                                    |                    |                               | 592.7618 (376)           |
| Pumps and fans                                                                             | 85.5868            | 0.5190                        | 44.4196 (378)            |
| Energy for lighting                                                                        | 245.8986           | 0.5190                        | 127.6214 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 764.8027 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.3100 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 14.3100 ZC1 |
| Total Floor Area                                                                | 53.4500     |
| Assumed number of occupants                                                     | 1.7918      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   | 17.3154 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 3.0309 ZC3  |
| Total CO2 emissions                                                             | 34.6563 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 34.6563 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4500 (1b)              | x 2.5000 (2b)                   | = 133.6250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4500                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1497 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3997 (18)                |
|                                                      |                              |                      |       |       | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3397 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4331 | 0.4247 | 0.4162 | 0.3737 | 0.3652 | 0.3227 | 0.3227 | 0.3142 | 0.3397 | 0.3652 | 0.3822 | 0.3992 (22b) |
| Effective ac    | 0.5938 | 0.5902 | 0.5866 | 0.5698 | 0.5667 | 0.5521 | 0.5521 | 0.5494 | 0.5577 | 0.5667 | 0.5730 | 0.5797 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 13.3700              | 1.3258           | 17.7254      |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 40.0425     | 13.3700        | 26.6725              | 0.1800           | 4.8011       |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 40.0425              |                  |              |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  |              | 22.5264           |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |                      |                  |              |                   |               | 2.0021 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 24.5286       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 26.1847     | 26.0241        | 25.8666              | 25.1271          | 24.9887      | 24.3446           | 24.3446       | 24.2253       | 24.5927 | 24.9887 | 25.2686 | 25.5613 | (38) |
| Heat transfer coeff                                                 | 50.7132     | 50.5526        | 50.3952              | 49.6556          | 49.5173      | 48.8732           | 48.8732       | 48.7539       | 49.1213 | 49.5173 | 49.7972 | 50.0898 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |               |         |         |         | 49.6550 | (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.9488      | 0.9458         | 0.9428               | 0.9290           | 0.9264       | 0.9144            | 0.9144        | 0.9121        | 0.9190  | 0.9264  | 0.9317  | 0.9371  | (40) |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |               |         |         |         | 0.9290  | (40) |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7918 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 76.7557 (43)   |
| Daily hot water use                                         | 84.4313  | 81.3610  | 78.2908  | 75.2206 | 72.1503 | 69.0801 | 69.0801 | 72.1503 | 75.2206 | 78.2908            | 81.3610  | 84.4313 (44)   |
| Energy conte                                                | 125.2091 | 109.5087 | 113.0032 | 98.5189 | 94.5312 | 81.5733 | 75.5896 | 86.7402 | 87.7761 | 102.2946           | 111.6626 | 121.2583 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1207.6658 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.7814  | 16.4263  | 16.9505  | 14.7778 | 14.1797 | 12.2360 | 11.3384 | 13.0110 | 13.1664 | 15.3442            | 16.7494  | 18.1888 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                                   | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.8040 | 151.5944 | 159.5981 | 143.6107 | 141.1261 | 126.6651 | 122.1845 | 133.3351                                  | 132.8680 | 148.8895 | 156.7544 | 167.8532 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.8040 | 151.5944 | 159.5981 | 143.6107 | 141.1261 | 126.6651 | 122.1845 | 133.3351                                  | 132.8680 | 148.8895 | 156.7544 | 167.8532 (64)  |
|                                                                 | 78.9080  | 70.0802  | 74.8495  | 68.8310  | 68.7076  | 63.1966  | 62.4095  | 66.1170                                   | 65.2590  | 71.2889  | 73.2013  | 77.5943 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          | 1756.2832 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | 89.5909  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9238  | 12.3670  | 10.0575  | 7.6142   | 5.6917   | 4.8052   | 5.1922   | 6.7490   | 9.0584   | 11.5018  | 13.4243  | 14.3108  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.1827 | 157.8033 | 153.7193 | 145.0247 | 134.0495 | 123.7343 | 116.8431 | 115.2224 | 119.3065 | 128.0010 | 138.9763 | 149.2915 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | 31.9591  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | -71.6727 | (71) |
| Water heating gains (Table 5)                                                       | 106.0591 | 104.2860 | 100.6041 | 95.5986  | 92.3489  | 87.7730  | 83.8837  | 88.8670  | 90.6376  | 95.8184  | 101.6684 | 104.2934 | (72) |
| Total internal gains                                                                | 329.0428 | 327.3336 | 317.2582 | 301.1148 | 284.9673 | 269.1897 | 258.7962 | 263.7156 | 271.8797 | 288.1984 | 306.9462 | 320.7730 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          |          |          |          |          |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | Specific data<br>or Table 6c | FF     | Access<br>factor<br>Table 6d | Gains<br>W |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|--------------------------------|------------------------------|------------------------------|--------|------------------------------|------------|
| Southeast   |          |          |          |          |          |          |          |          |          |          |          |          | 6.3700     | 36.7938                        | 0.6300                       | 0.7000                       | 0.7700 | 71.6286                      | (77)       |
| Southwest   |          |          |          |          |          |          |          |          |          |          |          |          | 7.0000     | 36.7938                        | 0.6300                       | 0.7000                       | 0.7700 | 78.7127                      | (79)       |
| -----       |          |          |          |          |          |          |          |          |          |          |          |          |            |                                |                              |                              |        |                              |            |
| Solar gains | 150.3413 | 256.0868 | 350.3892 | 434.1492 | 486.2832 | 482.7667 | 465.4386 | 426.5443 | 379.3974 | 283.0305 | 180.0742 | 128.6608 | (83)       |                                |                              |                              |        |                              |            |
| Total gains | 479.3841 | 583.4205 | 667.6473 | 735.2640 | 771.2505 | 751.9564 | 724.2348 | 690.2599 | 651.2771 | 571.2289 | 487.0204 | 449.4338 | (84)       |                                |                              |                              |        |                              |            |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 73.1921 | 73.4246 | 73.6540 | 74.7509 | 74.9598 | 75.9477 | 75.9477 | 76.1335 | 75.5641 | 74.9598 | 74.5385 | 74.1030 |              |
| alpha                                                                       | 5.8795  | 5.8950  | 5.9103  | 5.9834  | 5.9973  | 6.0632  | 6.0632  | 6.0756  | 6.0376  | 5.9973  | 5.9692  | 5.9402  |              |
| util living area                                                            | 0.9844  | 0.9558  | 0.8909  | 0.7581  | 0.5859  | 0.4148  | 0.2968  | 0.3247  | 0.5155  | 0.8091  | 0.9602  | 0.9886  | (86)         |
| MIT                                                                         | 20.3160 | 20.5323 | 20.7518 | 20.9205 | 20.9841 | 20.9984 | 20.9998 | 20.9997 | 20.9942 | 20.9033 | 20.5891 | 20.2740 | (87)         |
| Th 2                                                                        | 20.1262 | 20.1288 | 20.1312 | 20.1429 | 20.1451 | 20.1553 | 20.1553 | 20.1572 | 20.1514 | 20.1451 | 20.1407 | 20.1361 | (88)         |
| util rest of house                                                          | 0.9800  | 0.9446  | 0.8672  | 0.7181  | 0.5358  | 0.3606  | 0.2399  | 0.2653  | 0.4542  | 0.7650  | 0.9481  | 0.9853  | (89)         |
| MIT 2                                                                       | 19.2371 | 19.5440 | 19.8425 | 20.0617 | 20.1318 | 20.1543 | 20.1552 | 20.1571 | 20.1475 | 20.0494 | 19.6378 | 19.1845 | (90)         |
| Living area fraction                                                        | 19.7254 | 19.9913 | 20.2540 | 20.4504 | 20.5176 | 20.5363 | 20.5375 | 20.5384 | 20.5307 | 20.4359 | 20.0684 | 19.6776 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.7254 | 19.9913 | 20.2540 | 20.4504 | 20.5176 | 20.5363 | 20.5375 | 20.5384 | 20.5307 | 20.4359 | 20.0684 | 19.6776 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |       |
| Useful gains         | 0.9775   | 0.9426   | 0.8708   | 0.7329   | 0.5579   | 0.3851   | 0.2656   | 0.2922   | 0.4818   | 0.7808   | 0.9470   | 0.9831   | (94)  |
| Ext temp.            | 468.5844 | 549.9096 | 581.3929 | 538.8889 | 430.2575 | 289.5723 | 192.3912 | 201.6832 | 313.8104 | 446.0083 | 461.1853 | 441.8543 | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000   | (96)  |
| Month fracti         | 782.2721 | 762.9033 | 693.1359 | 573.5404 | 436.6222 | 290.1264 | 192.4369 | 201.7644 | 315.8841 | 487.0453 | 645.7874 | 775.2692 | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | (97a) |
| Space heating per m2 | 233.3837 | 143.1318 | 83.1368  | 24.9491  | 4.7354   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 30.5315  | 132.9135 | 248.0607 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 900.8424 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 16.8539  | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)   |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)   |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 963.4679 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                |
| Space heating requirement                                             | 233.3837 | 143.1318 | 83.1368  | 24.9491  | 4.7354   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 30.5315  | 132.9135 | 248.0607  | (98)           |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)          |
| Space heating fuel (main heating system)                              | 249.6082 | 153.0821 | 88.9164  | 26.6836  | 5.0646   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 32.6540  | 142.1534 | 265.3055  | (211)          |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)          |
| Water heating requirement                                             | 171.8040 | 151.5944 | 159.5981 | 143.6107 | 141.1261 | 126.6651 | 122.1845 | 133.3351 | 132.8680 | 148.8895 | 156.7544 | 167.8532  | (64)           |
| Efficiency of water heater                                            | 85.6315  | 84.6611  | 83.1678  | 81.2214  | 80.1075  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.4385  | 84.3775  | 85.8541   | (216)          |
| Fuel for water heating, kWh/month                                     | 200.6317 | 179.0602 | 191.8988 | 176.8140 | 176.1710 | 158.7282 | 153.1134 | 167.0866 | 166.5012 | 182.8246 | 185.7775 | 195.5098  | (219)          |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          | 2134.1169 | (219)          |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 963.4679  | (211)          |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)          |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)         |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)         |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)          |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 245.8986  | (232)          |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3418.4834 | (238)          |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 963.4679           | 0.2160                        | 208.1091 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2134.1169          | 0.2160                        | 460.9693 (264)           |
| Space and water heating                                                                           |                    |                               | 669.0783 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 245.8986           | 0.5190                        | 127.6214 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 835.6247 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.5178 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3877 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7283 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.5178 * 1.00) + 2.3877 + 0.7283, rounded to 2 d.p. |                    |                               | 15.6300 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000582                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.09_2B |                |            |
| Property                           | A_2_14.09_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 15.27        | TER            | 14.69      |
| Environmental                      | 88 B                                | % DER<TER     | -3.97        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.99                                | DFEE          | 41.03        | TFEE           | 34.26      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -19.78       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 75 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.69 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.27 kgCO<sub>2</sub>/m<sup>2</sup>Fail  
Excess emissions =0.58 kgCO<sub>2</sub>/m<sup>2</sup> (3.9%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)34.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)41.0 kWh/m<sup>2</sup>/yrFail  
Excess energy =6.7 kWh/m<sup>2</sup>/yr (19.5%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                            |    |
|-------------------------|--------------------------------------------------------------------------------------------|----|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room stats | OK |
|-------------------------|--------------------------------------------------------------------------------------------|----|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |     |    |
|----------------------------------------------------------|-----|----|
| Percentage of fixed lights with low-energy fittings:100% |     |    |
| Minimum                                                  | 75% | OK |

#### 8 Mechanical ventilation

|                                      |      |    |
|--------------------------------------|------|----|
| Continuous supply and extract system |      |    |
| Specific fan power:                  | 0.44 |    |
| Maximum                              | 1.5  | OK |
| MVHR efficiency:                     | 91%  |    |
| Minimum:                             | 70%  | OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 14.40 m <sup>2</sup> , No overhang |
| Windows facing North West: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 28.8000              | 1.3258           | 38.1818      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 50.1023       | 28.8000        | 21.3023              | 0.1600           | 3.4084       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 50.1023              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...(30) + (32) = |                  | 41.5902      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 74.6000              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 74.6000              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                      |                  |              |                   | 7.5153 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                      |                  |              |                   | 49.1055 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                      |                  |              |                   |               |         |         |         |         |              |
| (38)m                                                               | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 16.9749       | 16.7787        | 16.5825              | 15.6017          | 15.4055      | 14.4246           | 14.4246       | 14.2284 | 14.8170 | 15.4055 | 15.7978 | 16.1902 (38) |
|                                                                     | 66.0804       | 65.8842        | 65.6881              | 64.7072          | 64.5110      | 63.5301           | 63.5301       | 63.3340 | 63.9225 | 64.5110 | 64.9034 | 65.2957 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                      |                  |              |                   |               |         |         |         |         | 64.6581 (39) |
| HLP                                                                 | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 0.8858        | 0.8832         | 0.8805               | 0.8674           | 0.8648       | 0.8516            | 0.8516        | 0.8490  | 0.8569  | 0.8648  | 0.8700  | 0.8753 (40)  |
| Days in month                                                       | 31            | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.3524 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 90.0704 (43)                      |
| Daily hot water use                      | Jan 99.0774 | Feb 95.4746 | Mar 91.8718 | Apr 88.2690 | May 84.6661 | Jun 81.0633 | Jul 81.0633 | Aug 84.6661 | Sep 88.2690 | Oct 91.8718 | Nov 95.4746 | Dec 99.0774 (44)                  |
| Energy conte                             | 146.9289    | 128.5050    | 132.6056    | 115.6088    | 110.9294    | 95.7236     | 88.7020     | 101.7869    | 103.0025    | 120.0395    | 131.0325    | 142.2928 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 22.0393     | 19.2757     | 19.8908     | 17.3413     | 16.6394     | 14.3585     | 13.3053     | 15.2680     | 15.4504     | 18.0059     | 19.6549     | 21.3439 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



**Design SAP**  
elmhurst energy

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |               |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)   |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |
| Primary loss                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637 | 156.4962 | 175.3163 | 184.5262 | 197.5696 (62) |
| Solar input                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Solar input (sum of months) = Sum(63)m = 0.0000 (63)            |          |          |          |          |          |          |          |          |          |          |          |               |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637 | 156.4962 | 175.3163 | 184.5262 | 197.5696 (64) |
| Total per year (kWh/year) = Sum(64)m = 2067.9974 (64)           |          |          |          |          |          |          |          |          |          |          |          |               |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 93.0753  | 82.6699  | 88.3128  | 81.2349  | 81.1055  | 74.6231  | 73.7149  | 78.0656  | 77.0433  | 84.1346  | 86.3633  | 91.5338 (65)  |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.5244  | 16.4532  | 13.8006  | 10.1300  | 7.5723   | 6.3928   | 6.9077   | 8.9789   | 12.0514  | 15.3021  | 17.8598  | 19.0392 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 207.7869 | 209.9431 | 204.5096 | 192.9423 | 178.3407 | 164.6172 | 155.4491 | 153.2929 | 158.7264 | 170.2937 | 184.8953 | 198.6188 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 (71) |
| Water heating gains (Table 5)                                                       | 125.1012 | 123.0206 | 118.7000 | 112.8262 | 109.0127 | 103.6431 | 99.0791  | 104.9268 | 107.0046 | 113.0841 | 119.9490 | 123.0293 (72) |
| Total internal gains                                                                | 409.6990 | 407.7034 | 394.8767 | 374.1850 | 353.2122 | 332.9397 | 319.7225 | 325.4852 | 336.0690 | 356.9664 | 380.9906 | 398.9738 (73) |

| [Jan]       |          |          |          |          | Area     | Solar flux | g           |          | FF            |             |          | Access   | Gains        |      |
|-------------|----------|----------|----------|----------|----------|------------|-------------|----------|---------------|-------------|----------|----------|--------------|------|
|             |          |          |          |          | m2       | Table 6a   | or Table 6b |          | Specific data | or Table 6c |          | factor   | W            |      |
|             |          |          |          |          |          | W/m2       |             |          |               |             |          | Table 6d |              |      |
| Southwest   |          |          |          |          | 14.4000  | 36.7938    | 0.3000      |          | 0.8000        |             |          | 0.7700   | 88.1215 (79) |      |
| Northwest   |          |          |          |          | 14.4000  | 11.2829    | 0.3000      |          | 0.8000        |             |          | 0.7700   | 27.0227 (81) |      |
|             |          |          |          |          |          |            |             |          |               |             |          |          |              |      |
| Solar gains | 115.1443 | 205.1091 | 304.4808 | 417.2284 | 503.8060 | 516.2071   | 491.0018    | 423.9581 | 343.1392      | 233.1176    | 139.5509 |          | 97.4818      | (83) |
| Total gains | 524.8433 | 612.8125 | 699.3575 | 791.4134 | 857.0183 | 849.1468   | 810.7243    | 749.4433 | 679.2081      | 590.0840    | 520.5415 |          | 496.4556     | (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 31.3591 | 31.4525 | 31.5464 | 32.0246 | 32.1220 | 32.6179 | 32.6179 | 32.7190 | 32.4177                   | 32.1220 | 31.9278 | 31.7360      |
| alpha                                                                       | 3.0906  | 3.0968  | 3.1031  | 3.1350  | 3.1415  | 3.1745  | 3.1745  | 3.1813  | 3.1612                    | 3.1415  | 3.1285  | 3.1157       |
| util living area                                                            | 0.9446  | 0.9137  | 0.8582  | 0.7541  | 0.6113  | 0.4536  | 0.3370  | 0.3767  | 0.5797                    | 0.8048  | 0.9156  | 0.9519 (86)  |
| MIT                                                                         | 19.3978 | 19.6784 | 20.0694 | 20.5057 | 20.7978 | 20.9427 | 20.9832 | 20.9760 | 20.8738                   | 20.4791 | 19.8713 | 19.3473 (87) |
| Th 2                                                                        | 20.1796 | 20.1818 | 20.1841 | 20.1953 | 20.1976 | 20.2088 | 20.2088 | 20.2111 | 20.2043                   | 20.1976 | 20.1931 | 20.1886 (88) |
| util rest of house                                                          | 0.9376  | 0.9032  | 0.8416  | 0.7272  | 0.5725  | 0.4037  | 0.2791  | 0.3161  | 0.5274                    | 0.7765  | 0.9036  | 0.9457 (89)  |
| MIT 2                                                                       | 18.0280 | 18.4298 | 18.9834 | 19.5912 | 19.9734 | 20.1560 | 20.1971 | 20.1935 | 20.0795                   | 19.5710 | 18.7193 | 17.9615 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3606 (91)  |
| MIT                                                                         | 18.5220 | 18.8800 | 19.3750 | 19.9209 | 20.2707 | 20.4397 | 20.4805 | 20.4756 | 20.3659                   | 19.8984 | 19.1347 | 18.4612 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.5220 | 18.8800 | 19.3750 | 19.9209 | 20.2707 | 20.4397 | 20.4805 | 20.4756 | 20.3659                   | 19.8984 | 19.1347 | 18.4612 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9196   | 0.8833   | 0.8228   | 0.7173   | 0.5761   | 0.4186   | 0.2992   | 0.3367   | 0.5384   | 0.7647       | 0.8847   | 0.9289 (94)    |
| Useful gains         | 482.6634 | 541.2700 | 575.4103 | 567.7080 | 493.7581 | 355.4281 | 242.5846 | 252.3606 | 365.7140 | 451.2546     | 460.5235 | 461.1463 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 939.7928 | 921.0633 | 845.7349 | 713.1345 | 552.9052 | 370.9975 | 246.5312 | 258.1270 | 400.5311 | 599.8518     | 781.0931 | 931.1950 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 340.1043 | 255.2211 | 201.1215 | 104.7071 | 44.0055  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 110.5563     | 230.8101 | 349.7162 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1636.2420 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 21.9335 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1636.2420 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1718.0541 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2067.9974 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2171.3973 (310a) |
| Electricity used for heat distribution                                                  | 38.8945 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 125.1415 (330a)  |
| Total electricity for the above, kWh/year                                               | 125.1415 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 327.1458 (332)   |
| Total delivered energy for all uses                                                     | 4341.7387 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 4094.1594          | 0.2160                        | 884.3384 (367)           |
| Electrical energy for heat distribution                                                    | 38.8945            | 0.5190                        | 20.1863 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 904.5247 (373)           |
| Space and water heating                                                                    |                    |                               | 904.5247 (376)           |
| Pumps and fans                                                                             | 125.1415           | 0.5190                        | 64.9484 (378)            |
| Energy for lighting                                                                        | 327.1458           | 0.5190                        | 169.7887 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1139.2618 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 15.2700 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 15.2700 ZC1 |
| Total Floor Area                                                                | TFA 74.6000 |
| Assumed number of occupants                                                     | N 2.3524    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.5054 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.3520 ZC3  |
| Total CO2 emissions                                                             | 34.1274 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 34.1274 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 30.0000 / (5) = 0.1609 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4109 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3492 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4453 | 0.4365 | 0.4278 | 0.3842 | 0.3754 | 0.3318 | 0.3318 | 0.3230 | 0.3492 | 0.3754 | 0.3929 | 0.4103 (22b) |
|                 | 0.5991 | 0.5953 | 0.5915 | 0.5738 | 0.5705 | 0.5550 | 0.5550 | 0.5522 | 0.5610 | 0.5705 | 0.5772 | 0.5842 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 18.6500                   | 1.3258                        | 24.7254      |                                | (27)          |
| External Wall 1                                                     | 50.1023                 | 18.6500                    | 31.4523                   | 0.1800                        | 5.6614       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 50.1023                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 30.3868      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 2.5051 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 32.8919 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| Jan                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Feb                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Mar                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Apr                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| May                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Jun                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Jul                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Aug                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Sep                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Oct                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Nov                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Dec                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Heat transfer coeff                                                 | 69.7655                 | 69.5285                    | 69.2963                   | 68.2056                       | 68.0015      | 67.0515                        | 67.0515       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| Jan                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Feb                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Mar                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Apr                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| May                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Jun                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Jul                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Aug                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Sep                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Oct                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Nov                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Dec                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                | 0.9229 (40)   |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              |                                | 0.9143 (40)   |
|                                                                     |                         |                            |                           |                               |              |                                | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |              |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|--------------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |              | 2.3524 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |              | 90.0704 (43)   |
| Jan                                                         | 99.0774  | 95.4746  | 91.8718  | 88.2690  | 84.6661  | 81.0633 | 81.0633 | 84.6661  | 88.2690  | 91.8718            | 95.4746      | 99.0774 (44)   |
| Energy conte                                                | 146.9289 | 128.5050 | 132.6056 | 115.6088 | 110.9294 | 95.7236 | 88.7020 | 101.7869 | 103.0025 | 120.0395           | 131.0325     | 142.2928 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |              | 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |          |          |                    |              |                |
| 22.0393                                                     | 19.2757  | 19.8908  | 17.3413  | 16.6394  | 14.3585  | 13.3053 | 15.2680 | 15.4504  | 18.0059  | 19.6549            | 21.3439 (46) |                |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |              |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |              | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |              | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |              | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |              | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |              |                |
| 23.3325                                                     | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325 | 22.5798  | 23.3325  | 22.5798            | 23.3325 (56) |                |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |          |          |                    |              |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (64)  |
|                                                                 | 86.1298  | 76.3965  | 81.3673  | 74.5134  | 74.1599  | 67.9016  | 66.7693  | 71.1201                       | 70.3218     | 77.1891  | 79.6418  | 84.5883 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1965.7751 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 18.5244  | 16.4532  | 13.3806  | 10.1300  | 7.5723   | 6.3928   | 6.9077   | 8.9789   | 12.0514  | 15.3021  | 17.8598  | 19.0392 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 207.7869 | 209.9431 | 204.5096 | 192.9423 | 178.3407 | 164.6172 | 155.4491 | 153.2929 | 158.7264 | 170.2937 | 184.8953 | 198.6188 (68) |
| Pumps, fans                                                                         | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 (71) |
| Total internal gains                                                                | 115.7659 | 113.6852 | 109.3646 | 103.4908 | 99.6773  | 94.3078  | 89.7437  | 95.5915  | 97.6692  | 103.7487 | 110.6136 | 113.6939 (72) |
|                                                                                     | 403.3636 | 401.3680 | 388.5414 | 367.8496 | 346.8769 | 326.6044 | 313.3871 | 319.1498 | 329.7336 | 350.6311 | 374.6552 | 392.6385 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          |            |               |          |               |          |          |               | Gains         |
|-------------|----------|----------|----------|----------|------------|---------------|----------|---------------|----------|----------|---------------|---------------|
|             | Area     |          |          |          | Solar flux | g             |          | FF            |          | Access   | Gains         |               |
|             | m2       |          |          |          | Table 6a   | Specific data |          | Specific data |          | factor   | W             |               |
|             |          |          |          |          | W/m2       | or Table 6b   |          | or Table 6c   |          | Table 6d |               |               |
| Southwest   | 9.3200   |          |          |          | 36.7938    | 0.6300        |          | 0.7000        |          | 0.7700   | 104.8004 (79) |               |
| Northwest   | 9.3300   |          |          |          | 11.2829    | 0.6300        |          | 0.7000        |          | 0.7700   | 32.1718 (81)  |               |
|             |          |          |          |          |            |               |          |               |          |          |               |               |
| Solar gains | 136.9722 | 244.0005 | 362.2365 | 496.4052 | 599.4410   | 614.2077      | 584.2125 | 504.4230      | 408.2395 | 277.3257 | 166.0072      | 115.9604 (83) |
| Total gains | 540.3358 | 645.3685 | 750.7779 | 864.2549 | 946.3178   | 940.8120      | 897.5996 | 823.5728      | 737.9731 | 627.9567 | 540.6624      | 508.5989 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
| tau                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| alpha                                                                       | 74.2567 | 74.5098 | 74.7595 | 75.9550 | 76.1829 | 77.2623 | 77.2623 | 77.4655 | 76.8429 | 76.1829 | 75.7232 | 75.2485      |
| util living area                                                            | 5.9504  | 5.9673  | 5.9840  | 6.0637  | 6.0789  | 6.1508  | 6.1508  | 6.1644  | 6.1229  | 6.0789  | 6.0482  | 6.0166       |
|                                                                             | 0.9944  | 0.9838  | 0.9492  | 0.8379  | 0.6480  | 0.4541  | 0.3284  | 0.3730  | 0.6160  | 0.9044  | 0.9855  | 0.9960 (86)  |
| MIT                                                                         | 20.1775 | 20.3649 | 20.6167 | 20.8670 | 20.9747 | 20.9975 | 20.9997 | 20.9994 | 20.9860 | 20.8166 | 20.4503 | 20.1463 (87) |
| Th 2                                                                        | 20.1377 | 20.1404 | 20.1430 | 20.1554 | 20.1577 | 20.1685 | 20.1685 | 20.1705 | 20.1643 | 20.1577 | 20.1530 | 20.1481 (88) |
| util rest of house                                                          | 0.9927  | 0.9791  | 0.9352  | 0.8029  | 0.5959  | 0.3961  | 0.2665  | 0.3060  | 0.5473  | 0.8731  | 0.9805  | 0.9947 (89)  |
| MIT 2                                                                       | 19.0467 | 19.3190 | 19.6756 | 20.0133 | 20.1360 | 20.1670 | 20.1684 | 20.1703 | 20.1547 | 19.9617 | 19.4542 | 19.0093 (90) |
| Living area fraction                                                        | 19.4545 | 19.6961 | 20.0150 | 20.3211 | 20.4384 | 20.4665 | 20.4682 | 20.4693 | 20.4545 | 20.2700 | 19.8134 | 19.4193 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.4545 | 19.6961 | 20.0150 | 20.3211 | 20.4384 | 20.4665 | 20.4682 | 20.4693 | 20.4545 | 20.2700 | 19.8134 | 19.4193 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9909    | 0.9760    | 0.9328   | 0.8102   | 0.6136   | 0.4170   | 0.2889   | 0.3302   | 0.5716   | 0.8777       | 0.9779   | 0.9933 (94)    |
| Ext temp.            | 535.4227  | 629.8829  | 700.3457 | 700.2396 | 580.6572 | 392.2834 | 259.2778 | 271.9364 | 421.8341 | 551.1765     | 528.7084 | 505.1949 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1057.2582 | 1028.7515 | 936.5382 | 778.9835 | 594.2261 | 393.3576 | 259.3668 | 272.1342 | 428.4038 | 657.5728     | 869.7777 | 1047.7890 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 388.2456  | 268.0397  | 175.7272 | 56.6956  | 10.0952  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.1588      | 245.5699 | 403.6900 (98)  |
|                      |           |           |          |          |          |          |          |          |          |              |          | 1627.2220 (98) |
|                      |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 21.8126 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1740.3444 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 388.2456 | 268.0397 | 175.7272 | 56.6956  | 10.0952  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.1588  | 245.5699 | 403.6900  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 415.2359 | 286.6735 | 187.9435 | 60.6370  | 10.7971  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.6618  | 262.6416 | 431.7540  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818 | 148.0944 | 166.6344 | 176.1244 | 188.8877  | (64)            |
| Efficiency of water heater                                            | 86.6358  | 86.0145  | 84.7617  | 82.3389  | 80.3723  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.9588  | 85.7006  | 86.7905   | (217)           |
| Fuel for water heating, kWh/month                                     | 223.3763 | 198.3278 | 211.4168 | 195.1699 | 195.9932 | 176.4605 | 169.5450 | 185.9421 | 185.5819 | 200.8640 | 205.5112 | 217.6363  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2365.8251 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1740.3444 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 327.1458  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4508.3153 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1740.3444          | 0.2160                        | 375.9144 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2365.8251          | 0.2160                        | 511.0182 (264)           |
| Space and water heating                                                                           |                    |                               | 886.9326 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 327.1458           | 0.5190                        | 169.7887 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1095.6463 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.8892 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2760 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5218 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.8892 * 1.00) + 2.2760 + 0.5218, rounded to 2 d.p. |                    |                               | 14.6900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000626                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.09_2B |                |            |
| Property                           | A_2_14.09_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.87        | TER            | 14.69      |
| Environmental                      | 90 B                                | % DER<TER     | 12.37        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.86                                | DFEE          | 31.64        | TFEE           | 34.26      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 7.63         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 75 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.69 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.87 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 34.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 31.6 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                            |    |
|-------------------------|--------------------------------------------------------------------------------------------|----|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room stats | OK |
|-------------------------|--------------------------------------------------------------------------------------------|----|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                      |      |    |
|------------------------------------------------------|------|----|
| Percentage of fixed lights with low-energy fittings: | 100% |    |
| Minimum                                              | 75%  | OK |

#### 8 Mechanical ventilation

|                                      |      |    |
|--------------------------------------|------|----|
| Continuous supply and extract system |      |    |
| Specific fan power:                  | 0.44 |    |
| Maximum                              | 1.5  | OK |
| MVHR efficiency:                     | 91%  |    |
| Minimum:                             | 70%  | OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 14.40 m <sup>2</sup> , No overhang |
| Windows facing North West: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Opening Type 1 (Uw = 1.00)                                          |                |                | 28.8000              | 0.9615           | 27.6923        |                   | (27)           |                |                |                |                |                     |
| External Wall 1                                                     | 50.1023        | 28.8000        | 21.3023              | 0.1600           | 3.4084         |                   | (29a)          |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 50.1023              |                  |                |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 31.1007        |                   | (33)           |                |                |                |                |                     |
| Party Floor 1                                                       |                |                | 74.6000              |                  |                |                   | (32d)          |                |                |                |                |                     |
| Party Ceilings 1                                                    |                |                | 74.6000              |                  |                |                   | (32b)          |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   | 100.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (Default value 0.150 * total exposed area)          |                |                |                      |                  |                |                   | 7.5153 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              | (33) + (36) =  |                |                      |                  |                |                   | 38.6160 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>16.9749 | Feb<br>16.7787 | Mar<br>16.5825       | Apr<br>15.6017   | May<br>15.4055 | Jun<br>14.4246    | Jul<br>14.4246 | Aug<br>14.2284 | Sep<br>14.8170 | Oct<br>15.4055 | Nov<br>15.7978 | Dec<br>16.1902 (38) |
| Heat transfer coeff                                                 | 55.5909        | 55.3947        | 55.1986              | 54.2177          | 54.0215        | 53.0406           | 53.0406        | 52.8445        | 53.4330        | 54.0215        | 54.4139        | 54.8062 (39)        |
| Average = Sum(39)m / 12 =                                           | 54.1686 (39)   |                |                      |                  |                |                   |                |                |                |                |                |                     |
| HLP                                                                 | Jan<br>0.7452  | Feb<br>0.7426  | Mar<br>0.7399        | Apr<br>0.7268    | May<br>0.7241  | Jun<br>0.7110     | Jul<br>0.7110  | Aug<br>0.7084  | Sep<br>0.7163  | Oct<br>0.7241  | Nov<br>0.7294  | Dec<br>0.7347 (40)  |
| HLP (average)                                                       | 0.7261 (40)    |                |                      |                  |                |                   |                |                |                |                |                |                     |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.3524 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 90.0704 (43)                      |
| Daily hot water use                      | Jan 99.0774 | Feb 95.4746 | Mar 91.8718 | Apr 88.2690 | May 84.6661 | Jun 81.0633 | Jul 81.0633 | Aug 84.6661 | Sep 88.2690 | Oct 91.8718 | Nov 95.4746 | Dec 99.0774 (44)                  |
| Energy conte                             | 146.9289    | 128.5050    | 132.6056    | 115.6088    | 110.9294    | 95.7236     | 88.7020     | 101.7869    | 103.0025    | 120.0395    | 131.0325    | 142.2928 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 22.0393     | 19.2757     | 19.8908     | 17.3413     | 16.6394     | 14.3585     | 13.3053     | 15.2680     | 15.4504     | 18.0059     | 19.6549     | 21.3439 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637                                  | 156.4962 | 175.3163 | 184.5262 | 197.5696 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637                                  | 156.4962 | 175.3163 | 184.5262 | 197.5696 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          |               | 2067.9974 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |               |                |
|                                                                 | 93.0753  | 82.6699  | 88.3128  | 81.2349  | 81.1055  | 74.6231  | 73.7149  | 78.0656                                   | 77.0433  | 84.1346  | 86.3633  | 91.5338 (65)  |                |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8832   | 0.8104   | 0.7014   | 0.5440   | 0.3903   | 0.2635   | 0.1847   | 0.2130   | 0.3719   | 0.6306       | 0.8232   | 0.8990 (94)   |
| Useful gains         | 531.3383 | 607.4309 | 632.8677 | 581.7920 | 465.5808 | 314.4564 | 210.2265 | 219.7823 | 337.6881 | 470.0780     | 505.0794 | 504.7361 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 831.7453 | 818.5723 | 750.2039 | 623.7875 | 476.7066 | 316.4034 | 210.6190 | 220.4372 | 344.3786 | 526.5459     | 690.3458 | 821.3261 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 223.5029 | 141.8870 | 87.2981  | 30.2368  | 8.2776   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 42.0121      | 133.3918 | 235.5430 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 902.1493 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 12.0932 (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 902.1493 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 947.2568 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2067.9974 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2171.3973 (310a) |
| Electricity used for heat distribution                                                  | 31.1865 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 125.1415 (330a)  |
| Total electricity for the above, kWh/year                                               | 125.1415 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 327.1458 (332)   |
| Total delivered energy for all uses                                                     | 3570.9414 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3282.7938          | 0.2160                        | 709.0835 (367)           |
| Electrical energy for heat distribution                                                    | 31.1865            | 0.5190                        | 16.1858 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 725.2693 (373)           |
| Space and water heating                                                                    |                    |                               | 725.2693 (376)           |
| Pumps and fans                                                                             | 125.1415           | 0.5190                        | 64.9484 (378)            |
| Energy for lighting                                                                        | 327.1458           | 0.5190                        | 169.7887 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 960.0064 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.8700 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 12.8700 ZC1 |
| Total Floor Area                                                                | TFA 74.6000 |
| Assumed number of occupants                                                     | N 2.3524    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.5054 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.3520 ZC3  |
| Total CO2 emissions                                                             | 31.7274 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 31.7274 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 30.0000 / (5) = 0.1609 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4109 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3492 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4453 | 0.4365 | 0.4278 | 0.3842 | 0.3754 | 0.3318 | 0.3318 | 0.3230 | 0.3492 | 0.3754 | 0.3929 | 0.4103 (22b) |
|                 | 0.5991 | 0.5953 | 0.5915 | 0.5738 | 0.5705 | 0.5550 | 0.5550 | 0.5522 | 0.5610 | 0.5705 | 0.5772 | 0.5842 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 18.6500                   | 1.3258                        | 24.7254      |                                | (27)          |
| External Wall 1                                                     | 50.1023                 | 18.6500                    | 31.4523                   | 0.1800                        | 5.6614       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 50.1023                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 30.3868      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 2.5051 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 32.8919 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| Jan                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Feb                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Mar                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Apr                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| May                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Jun                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Jul                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Aug                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Sep                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Oct                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Nov                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Dec                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| Jan                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Feb                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Mar                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Apr                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| May                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Jun                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Jul                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Aug                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Sep                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Oct                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Nov                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Dec                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                | 0.9229 (40)   |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              |                                | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |              |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|--------------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |              | 2.3524 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |              | 90.0704 (43)   |
| Jan                                                         | 99.0774  | 95.4746  | 91.8718  | 88.2690  | 84.6661  | 81.0633 | 81.0633 | 84.6661  | 88.2690  | 91.8718            | 95.4746      | 99.0774 (44)   |
| Energy conte                                                | 146.9289 | 128.5050 | 132.6056 | 115.6088 | 110.9294 | 95.7236 | 88.7020 | 101.7869 | 103.0025 | 120.0395           | 131.0325     | 142.2928 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |              | 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |          |          |                    |              |                |
| 22.0393                                                     | 19.2757  | 19.8908  | 17.3413  | 16.6394  | 14.3585  | 13.3053 | 15.2680 | 15.4504  | 18.0059  | 19.6549            | 21.3439 (46) |                |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |              |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |              | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |              | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |              | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |              | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |              |                |
| 23.3325                                                     | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325 | 22.5798  | 23.3325  | 22.5798            | 23.3325 (56) |                |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |          |          |                    |              |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (64)  |
|                                                                 | 86.1298  | 76.3965  | 81.3673  | 74.5134  | 74.1599  | 67.9016  | 66.7693  | 71.1201                       | 70.3218     | 77.1891  | 79.6418  | 84.5883 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1965.7751 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 18.5244  | 16.4532  | 13.3806  | 10.1300  | 7.5723   | 6.3928   | 6.9077   | 8.9789   | 12.0514  | 15.3021  | 17.8598  | 19.0392 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 207.7869 | 209.9431 | 204.5096 | 192.9423 | 178.3407 | 164.6172 | 155.4491 | 153.2929 | 158.7264 | 170.2937 | 184.8953 | 198.6188 (68) |
| Pumps, fans                                                                         | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 (71) |
| Total internal gains                                                                | 115.7659 | 113.6852 | 109.3646 | 103.4908 | 99.6773  | 94.3078  | 89.7437  | 95.5915  | 97.6692  | 103.7487 | 110.6136 | 113.6939 (72) |
|                                                                                     | 403.3636 | 401.3680 | 388.5414 | 367.8496 | 346.8769 | 326.6044 | 313.3871 | 319.1498 | 329.7336 | 350.6311 | 374.6552 | 392.6385 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          |            |               |          |               |          |          |               | Gains         |
|-------------|----------|----------|----------|----------|------------|---------------|----------|---------------|----------|----------|---------------|---------------|
|             | Area     |          |          |          | Solar flux | g             |          | FF            |          | Access   | Gains         |               |
|             | m2       |          |          |          | Table 6a   | Specific data |          | Specific data |          | factor   | W             |               |
|             |          |          |          |          | W/m2       | or Table 6b   |          | or Table 6c   |          | Table 6d |               |               |
| Southwest   | 9.3200   |          |          |          | 36.7938    | 0.6300        |          | 0.7000        |          | 0.7700   | 104.8004 (79) |               |
| Northwest   | 9.3300   |          |          |          | 11.2829    | 0.6300        |          | 0.7000        |          | 0.7700   | 32.1718 (81)  |               |
|             |          |          |          |          |            |               |          |               |          |          |               |               |
| Solar gains | 136.9722 | 244.0005 | 362.2365 | 496.4052 | 599.4410   | 614.2077      | 584.2125 | 504.4230      | 408.2395 | 277.3257 | 166.0072      | 115.9604 (83) |
| Total gains | 540.3358 | 645.3685 | 750.7779 | 864.2549 | 946.3178   | 940.8120      | 897.5996 | 823.5728      | 737.9731 | 627.9567 | 540.6624      | 508.5989 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
| tau                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| alpha                                                                       | 74.2567 | 74.5098 | 74.7595 | 75.9550 | 76.1829 | 77.2623 | 77.2623 | 77.4655 | 76.8429 | 76.1829 | 75.7232 | 75.2485      |
| util living area                                                            | 5.9504  | 5.9673  | 5.9840  | 6.0637  | 6.0789  | 6.1508  | 6.1508  | 6.1644  | 6.1229  | 6.0789  | 6.0482  | 6.0166       |
|                                                                             | 0.9944  | 0.9838  | 0.9492  | 0.8379  | 0.6480  | 0.4541  | 0.3284  | 0.3730  | 0.6160  | 0.9044  | 0.9855  | 0.9960 (86)  |
| MIT                                                                         | 20.1775 | 20.3649 | 20.6167 | 20.8670 | 20.9747 | 20.9975 | 20.9997 | 20.9994 | 20.9860 | 20.8166 | 20.4503 | 20.1463 (87) |
| Th 2                                                                        | 20.1377 | 20.1404 | 20.1430 | 20.1554 | 20.1577 | 20.1685 | 20.1685 | 20.1705 | 20.1643 | 20.1577 | 20.1530 | 20.1481 (88) |
| util rest of house                                                          | 0.9927  | 0.9791  | 0.9352  | 0.8029  | 0.5959  | 0.3961  | 0.2665  | 0.3060  | 0.5473  | 0.8731  | 0.9805  | 0.9947 (89)  |
| MIT 2                                                                       | 19.0467 | 19.3190 | 19.6756 | 20.0133 | 20.1360 | 20.1670 | 20.1684 | 20.1703 | 20.1547 | 19.9617 | 19.4542 | 19.0093 (90) |
| Living area fraction                                                        | 19.4545 | 19.6961 | 20.0150 | 20.3211 | 20.4384 | 20.4665 | 20.4682 | 20.4693 | 20.4545 | 20.2700 | 19.8134 | 19.4193 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.4545 | 19.6961 | 20.0150 | 20.3211 | 20.4384 | 20.4665 | 20.4682 | 20.4693 | 20.4545 | 20.2700 | 19.8134 | 19.4193 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9909    | 0.9760    | 0.9328   | 0.8102   | 0.6136   | 0.4170   | 0.2889   | 0.3302   | 0.5716   | 0.8777       | 0.9779   | 0.9933 (94)    |
| Ext temp.            | 535.4227  | 629.8829  | 700.3457 | 700.2396 | 580.6572 | 392.2834 | 259.2778 | 271.9364 | 421.8341 | 551.1765     | 528.7084 | 505.1949 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1057.2582 | 1028.7515 | 936.5382 | 778.9835 | 594.2261 | 393.3576 | 259.3668 | 272.1342 | 428.4038 | 657.5728     | 869.7777 | 1047.7890 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 388.2456  | 268.0397  | 175.7272 | 56.6956  | 10.0952  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.1588      | 245.5699 | 403.6900 (98)  |
|                      |           |           |          |          |          |          |          |          |          |              |          | 1627.2220 (98) |
|                      |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 21.8126 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1740.3444 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 388.2456 | 268.0397 | 175.7272 | 56.6956  | 10.0952  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.1588  | 245.5699 | 403.6900  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 415.2359 | 286.6735 | 187.9435 | 60.6370  | 10.7971  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.6618  | 262.6416 | 431.7540  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818 | 148.0944 | 166.6344 | 176.1244 | 188.8877  | (64)            |
| Efficiency of water heater                                            | 86.6358  | 86.0145  | 84.7617  | 82.3389  | 80.3723  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.9588  | 85.7006  | 86.7905   | (217)           |
| Fuel for water heating, kWh/month                                     | 223.3763 | 198.3278 | 211.4168 | 195.1699 | 195.9932 | 176.4605 | 169.5450 | 185.9421 | 185.5819 | 200.8640 | 205.5112 | 217.6363  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2365.8251 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1740.3444 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 327.1458  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4508.3153 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1740.3444          | 0.2160                        | 375.9144 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2365.8251          | 0.2160                        | 511.0182 (264)           |
| Space and water heating                                                                           |                    |                               | 886.9326 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 327.1458           | 0.5190                        | 169.7887 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1095.6463 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.8892 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2760 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5218 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.8892 * 1.00) + 2.2760 + 0.5218, rounded to 2 d.p. |                    |                               | 14.6900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000654                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.10_1B |                |            |
| Property                           | A_2_14.10_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.03        | TER            | 14.75      |
| Environmental                      | 90 B                                | % DER<TER     | 4.87         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.68                                | DFEE          | 28.37        | TFEE           | 22.97      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -23.48       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 54 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.75 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.03 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)23.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)28.4 kWh/m<sup>2</sup>/yrFail  
Excess energy =5.4 kWh/m<sup>2</sup>/yr (23.5%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 13.51 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

#### 2. Ventilation rate

|                                                                                              |                              |        |        |        | main<br>heating | +      | secondary<br>heating | +      | other  | =      | total                       | m3 per hour   |
|----------------------------------------------------------------------------------------------|------------------------------|--------|--------|--------|-----------------|--------|----------------------|--------|--------|--------|-----------------------------|---------------|
| Number of chimneys                                                                           |                              |        |        |        | 0               | +      | 0                    | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a)   |
| Number of open flues                                                                         |                              |        |        |        | 0               | +      | 0                    | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b)   |
| Number of intermittent fans                                                                  |                              |        |        |        |                 |        |                      |        |        |        | 0 * 10 =                    | 0.0000 (7a)   |
| Number of passive vents                                                                      |                              |        |        |        |                 |        |                      |        |        |        | 0 * 10 =                    | 0.0000 (7b)   |
| Number of flueless gas fires                                                                 |                              |        |        |        |                 |        |                      |        |        |        | 0 * 40 =                    | 0.0000 (7c)   |
| Air changes per hour                                                                         |                              |        |        |        |                 |        |                      |        |        |        |                             |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |        |        |                 |        |                      |        |        |        | 0.0000 / (5) =              | 0.0000 (8)    |
| Pressure test                                                                                |                              |        |        |        |                 |        |                      |        |        |        | Yes                         |               |
| Measured/design AP50                                                                         |                              |        |        |        |                 |        |                      |        |        |        | 3.0000                      |               |
| Infiltration rate                                                                            |                              |        |        |        |                 |        |                      |        |        |        | 0.1500                      | (18)          |
| Number of sides sheltered                                                                    |                              |        |        |        |                 |        |                      |        |        |        | 3                           | (19)          |
| Shelter factor                                                                               |                              |        |        |        |                 |        |                      |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20)   |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |        |        |                 |        |                      |        |        |        | (21) = (18) x (20) =        | 0.1163 (21)   |
| Wind speed                                                                                   | Jan                          | Feb    | Mar    | Apr    | May             | Jun    | Jul                  | Aug    | Sep    | Oct    | Nov                         | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000 | 4.4000 | 4.3000          | 3.8000 | 3.8000               | 3.7000 | 4.0000 | 4.3000 | 4.5000                      | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250 | 1.1000 | 1.0750          | 0.9500 | 0.9500               | 0.9250 | 1.0000 | 1.0750 | 1.1250                      | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424 | 0.1279 | 0.1250          | 0.1104 | 0.1104               | 0.1075 | 0.1163 | 0.1250 | 0.1308                      | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |        |        |                 |        |                      |        |        |        |                             |               |
| If mechanical ventilation:                                                                   |                              |        |        |        |                 |        |                      |        |        |        |                             | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |        |        |                 |        |                      |        |        |        |                             | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2615                       | 0.2586 | 0.2557 | 0.2411 | 0.2382          | 0.2237 | 0.2237               | 0.2208 | 0.2295 | 0.2382 | 0.2440                      | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|------------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 13.5100                | 1.3258           | 17.9110      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 21.6370       | 13.5120        | 8.1250                 | 0.1600           | 1.3000       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 21.6350                |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26) ... (30) + (32) = |                  | 19.2110      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 53.5700                |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 53.5700                |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                        |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                        |                  |              |                   | 3.2453 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                        |                  |              |                   | 22.4562 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                        |                  |              |                   |               |         |         |         |         |              |
| (38)m                                                               | Jan           | Feb            | Mar                    | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 11.5557       | 11.4272        | 11.2988                | 10.6566          | 10.5281      | 9.8859            | 9.8859        | 9.7575  | 10.1428 | 10.5281 | 10.7850 | 11.0419 (38) |
|                                                                     | 34.0119       | 33.8835        | 33.7550                | 33.1128          | 32.9844      | 32.3422           | 32.3422       | 32.2137 | 32.5990 | 32.9844 | 33.2413 | 33.4981 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                        |                  |              |                   |               |         |         |         |         | 33.0807 (39) |
| HLP                                                                 | Jan           | Feb            | Mar                    | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 0.6349        | 0.6325         | 0.6301                 | 0.6181           | 0.6157       | 0.6037            | 0.6037        | 0.6013  | 0.6085  | 0.6157  | 0.6205  | 0.6253 (40)  |
| Days in month                                                       | 31            | 28             | 31                     | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.7954 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 76.8396 (43)                      |
| Daily hot water use                      | Jan 84.5236 | Feb 81.4500 | Mar 78.3764 | Apr 75.3028 | May 72.2292 | Jun 69.1556 | Jul 69.1556 | Aug 72.2292 | Sep 75.3028 | Oct 78.3764 | Nov 81.4500 | Dec 84.5236 (44)                  |
| Energy conte                             | 125.3460    | 109.6284    | 113.1267    | 98.6266     | 94.6346     | 81.6624     | 75.6723     | 86.8350     | 87.8721     | 102.4065    | 111.7847    | 121.3909 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1208.9861 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 18.8019     | 16.4443     | 16.9690     | 14.7940     | 14.1952     | 12.2494     | 11.3508     | 13.0253     | 13.1808     | 15.3610     | 16.7677     | 18.2086 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             |                                   |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |                |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|----------------|-------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |                |             |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)    |             |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)    |             |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)    |             |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)    |             |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |                |             |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)   |             |
| If cylinder contains dedicated solar storage                    | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)   |             |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |             |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |                |             |
|                                                                 | 180.6228 | 159.5558 | 168.4035 | 152.1203 | 149.9114 | 135.1561 | 130.9491 | 142.1118                                 | 141.3658 | 157.6833 | 165.2783 | 176.6677 (62)  |             |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |             |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |                | 0.0000 (63) |
| Output from w/h                                                 | 180.6228 | 159.5558 | 168.4035 | 152.1203 | 149.9114 | 135.1561 | 130.9491 | 142.1118                                 | 141.3658 | 157.6833 | 165.2783 | 176.6677 (64)  |             |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |                                          |          |          |          | 1859.8258 (64) |             |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |                |             |
|                                                                 | 85.8990  | 76.3934  | 81.8361  | 75.5883  | 75.6874  | 69.9477  | 69.3825  | 73.0941                                  | 72.0124  | 78.2716  | 79.9633  | 84.5839 (65)   |             |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9515  | 12.3916  | 10.0775  | 7.6293   | 5.7030   | 4.8147   | 5.2025   | 6.7624   | 9.0764   | 11.5246  | 13.4509  | 14.3392 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.4931 | 158.1170 | 154.0248 | 145.3130 | 134.3159 | 123.9802 | 117.0753 | 115.4514 | 119.5436 | 128.2554 | 139.2525 | 149.5882 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 (71) |
| Water heating gains (Table 5)                                                       | 115.4556 | 113.6806 | 109.9947 | 104.9837 | 101.7304 | 97.1496  | 93.2560  | 98.2447  | 100.0172 | 105.2038 | 111.0602 | 113.6881 (72) |
| Total internal gains                                                                | 335.8305 | 334.1195 | 324.0273 | 307.8563 | 291.6796 | 275.8748 | 265.4641 | 270.3888 | 278.5676 | 294.9141 | 313.6939 | 327.5458 (73) |

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|
| Southwest   |          |          |          | 13.5120    | 36.7938                        |          | 0.3000                            |          | 0.8000                             |          | 0.7700                       |          | 82.6874 (79) |
| Solar gains | 82.6874  | 140.8472 | 192.7132 | 238.7810   | 267.4547                       | 265.5206 | 255.9902                          | 234.5984 | 208.6677                           | 155.6661 | 99.0404                      | 70.7632  | (83)         |
| Total gains | 418.5178 | 474.9667 | 516.7405 | 546.6374   | 559.1343                       | 541.3954 | 521.4542                          | 504.9872 | 487.2352                           | 450.5802 | 412.7343                     | 398.3089 | (84)         |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 43.7510 | 43.9169 | 44.0840 | 44.9390 | 45.1140 | 46.0098 | 46.0098 | 46.1932 | 45.6472                   | 45.1140 | 44.7653 | 44.4220      |
| alpha                                                                       | 3.9167  | 3.9278  | 3.9389  | 3.9959  | 4.0076  | 4.0673  | 4.0673  | 4.0795  | 4.0431                    | 4.0076  | 3.9844  | 3.9615       |
| util living area                                                            | 0.8976  | 0.8482  | 0.7753  | 0.6612  | 0.5251  | 0.3776  | 0.2719  | 0.2920  | 0.4505                    | 0.6795  | 0.8418  | 0.9094 (86)  |
| MIT                                                                         | 20.2192 | 20.4204 | 20.6388 | 20.8396 | 20.9462 | 20.9894 | 20.9978 | 20.9971 | 20.9777                   | 20.8492 | 20.5319 | 20.1825 (87) |
| Th 2                                                                        | 20.3987 | 20.4008 | 20.4030 | 20.4137 | 20.4159 | 20.4266 | 20.4266 | 20.4288 | 20.4223                   | 20.4159 | 20.4116 | 20.4073 (88) |
| util rest of house                                                          | 0.8878  | 0.8351  | 0.7574  | 0.6375  | 0.4962  | 0.3450  | 0.2368  | 0.2563  | 0.4154                    | 0.6521  | 0.8262  | 0.9005 (89)  |
| MIT 2                                                                       | 19.3523 | 19.6355 | 19.9389 | 20.2176 | 20.3555 | 20.4165 | 20.4250 | 20.4265 | 20.4000                   | 20.2363 | 19.8044 | 19.3074 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5865 (91)  |
| MIT                                                                         | 19.8608 | 20.0958 | 20.3494 | 20.5824 | 20.7020 | 20.7525 | 20.7612 | 20.7612 | 20.7388                   | 20.5958 | 20.2311 | 19.8207 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.8608 | 20.0958 | 20.3494 | 20.5824 | 20.7020 | 20.7525 | 20.7610 | 20.7612 | 20.7388                   | 20.5958 | 20.2311 | 19.8207 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.8782   | 0.8279   | 0.7558   | 0.6445   | 0.5105   | 0.3636   | 0.2573   | 0.2771   | 0.4347   | 0.6607       | 0.8211   | 0.8908 (94)    |
| Useful gains         | 367.5217 | 393.2260 | 390.5346 | 352.2984 | 285.4203 | 196.8246 | 134.1703 | 139.9401 | 211.8215 | 297.7113     | 338.8951 | 354.8013 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 529.2524 | 514.8872 | 467.4864 | 386.8384 | 296.9245 | 198.9851 | 134.5751 | 140.4896 | 216.4195 | 329.7038     | 436.4934 | 523.2639 (97a) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 120.3276 | 81.7563  | 57.2521  | 24.8688  | 8.5592   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 23.8024      | 70.2708  | 125.3362 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 512.1734 (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 9.5608 (99)    |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 512.1734 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 537.7820 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1859.8258 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1952.8171 (310a) |
| Electricity used for heat distribution                                                  | 24.9060 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.7790 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.7790 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 246.3874 (332)   |
| Total delivered energy for all uses                                                     | 2822.7655 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2621.6833          | 0.2160                        | 566.2836 (367)           |
| Electrical energy for heat distribution                                                    | 24.9060            | 0.5190                        | 12.9262 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 579.2098 (373)           |
| Space and water heating                                                                    |                    |                               | 579.2098 (376)           |
| Pumps and fans                                                                             | 85.7790            | 0.5190                        | 44.5193 (378)            |
| Energy for lighting                                                                        | 246.3874           | 0.5190                        | 127.8751 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 751.6041 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.0300 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 14.0300 ZC1 |
| Total Floor Area                                                                | TFA | 53.5700     |
| Assumed number of occupants                                                     | N   | 1.7954      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.3109 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.0257 ZC3  |
| Total CO2 emissions                                                             |     | 34.3666 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 34.3666 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1493 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3993 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3095 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3946 | 0.3869 | 0.3791 | 0.3404 | 0.3327 | 0.2940 | 0.2940 | 0.2863 | 0.3095 | 0.3327 | 0.3482 | 0.3636 (22b) |
| Effective ac    | 0.5779 | 0.5748 | 0.5719 | 0.5579 | 0.5553 | 0.5432 | 0.5432 | 0.5410 | 0.5479 | 0.5553 | 0.5606 | 0.5661 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 13.4000                   | 1.3258                        | 17.7652      |                                | (27)          |
| External Wall 1                                                     | 21.6370                 | 13.4000                    | 8.2370                    | 0.1800                        | 1.4827       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 21.6370                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 19.2478      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.0819 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 20.3297 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 25.5383                 | 25.4047                    | 25.2738                   | 24.6587                       | 24.5436      | 24.0078                        | 24.0078       |
| Heat transfer coeff                                                 | 45.8680                 | 45.7344                    | 45.6034                   | 44.9883                       | 44.8732      | 44.3375                        | 44.3375       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| HLP                                                                 | 0.8562                  | 0.8537                     | 0.8513                    | 0.8398                        | 0.8377       | 0.8277                         | 0.8277        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                | 0.8258        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              |                                | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7954 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 76.8396 (43)   |
| Daily hot water use                                         | 84.5236  | 81.4500  | 78.3764  | 75.3028 | 72.2292 | 69.1556 | 69.1556 | 72.2292 | 75.3028 | 78.3764            | 81.4500  | 84.5236 (44)   |
| Energy conte                                                | 125.3460 | 109.6284 | 113.1267 | 98.6266 | 94.6346 | 81.6624 | 75.6723 | 86.8350 | 87.8721 | 102.4065           | 111.7847 | 121.3909 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1208.9861 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.8019  | 16.4443  | 16.9690  | 14.7940 | 14.1952 | 12.2494 | 11.3508 | 13.0253 | 13.1808 | 15.3610            | 16.7677  | 18.2086 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (64)  |
|                                                                 | 78.9535  | 70.1200  | 74.8905  | 68.8668  | 68.7419  | 63.2262  | 62.4369  | 66.1486                       | 65.2909     | 71.3261  | 73.2419  | 77.6384 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1757.6035 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9515  | 12.3916  | 10.0775  | 7.6293   | 5.7030   | 4.8147   | 5.2025   | 6.7624   | 9.0764   | 11.5246  | 13.4509  | 14.3392  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.4931 | 158.1170 | 154.0248 | 145.3130 | 134.3159 | 123.9802 | 117.0753 | 115.4514 | 119.5436 | 128.2554 | 139.2525 | 149.5882 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | (71) |
| Water heating gains (Table 5)                                                       | 106.1202 | 104.3453 | 100.6593 | 95.6484  | 92.3950  | 87.8142  | 83.9206  | 88.9094  | 90.6819  | 95.8684  | 101.7248 | 104.3527 | (72) |
| Total internal gains                                                                | 329.4951 | 327.7841 | 317.6919 | 301.5210 | 285.3442 | 269.5394 | 259.1287 | 264.0534 | 272.2322 | 288.5787 | 307.3585 | 321.2104 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|----------|---------------|
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |               |
| Southwest   |          |          |          | 13.4000    | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |          | 150.6786 (79) |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |               |
| Solar gains | 150.6786 | 256.6614 | 351.1754 | 435.1233   | 487.3744                       | 483.8500                          | 466.4830                           | 427.5014 | 380.2487 | 283.6656                     | 180.4783 | 128.9495 | (83)          |
| Total gains | 480.1737 | 584.4456 | 668.8673 | 736.6443   | 772.7186                       | 753.3894                          | 725.6117                           | 691.5548 | 652.4809 | 572.2443                     | 487.8368 | 450.1599 | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 81.1053 | 81.3423 | 81.5758 | 82.6912 | 82.9033 | 83.9051 | 83.9051 | 84.0932 | 83.5164                   | 82.9033 | 82.4754 | 82.0327 |              |
| alpha                                                                       | 6.4070  | 6.4228  | 6.4384  | 6.5127  | 6.5269  | 6.5937  | 6.5937  | 6.6062  | 6.5678                    | 6.5269  | 6.4984  | 6.4688  |              |
| util living area                                                            | 0.9807  | 0.9430  | 0.8606  | 0.7090  | 0.5356  | 0.3763  | 0.2688  | 0.2942  | 0.4693                    | 0.7649  | 0.9487  | 0.9861  | (86)         |
| MIT                                                                         | 20.4534 | 20.6568 | 20.8412 | 20.9590 | 20.9935 | 20.9995 | 21.0000 | 20.9999 | 20.9978                   | 20.9461 | 20.6951 | 20.4100 | (87)         |
| Th 2                                                                        | 20.2049 | 20.2070 | 20.2091 | 20.2190 | 20.2208 | 20.2294 | 20.2294 | 20.2310 | 20.2261                   | 20.2208 | 20.2171 | 20.2132 | (88)         |
| util rest of house                                                          | 0.9755  | 0.9298  | 0.8346  | 0.6707  | 0.4923  | 0.3311  | 0.2218  | 0.2451  | 0.4174                    | 0.7210  | 0.9345  | 0.9823  | (89)         |
| MIT 2                                                                       | 19.4964 | 19.7819 | 20.0274 | 20.1778 | 20.2155 | 20.2291 | 20.2294 | 20.2310 | 20.2247                   | 20.1687 | 19.8477 | 19.4412 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5865  | (91)         |
| MIT                                                                         | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |              |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |       |
|                      | 0.9743   | 0.9314   | 0.8448   | 0.6915   | 0.5174   | 0.3576   | 0.2494   | 0.2739   | 0.4478   | 0.7443   | 0.9371   | 0.9811       | (94)  |
| Useful gains         | 467.8455 | 544.3568 | 565.0262 | 509.3631 | 399.8384 | 269.4162 | 180.9425 | 189.4011 | 292.1741 | 425.9310 | 457.1389 | 441.6446     | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)  |
| Heat loss rate W     | 722.7746 | 704.0817 | 638.6621 | 527.9805 | 402.5945 | 269.6139 | 180.9569 | 189.4276 | 293.0165 | 449.8388 | 597.4181 | 716.9484     | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a) |
| Space heating kWh    | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874  | 101.0011 | 204.8260     | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 690.8570     | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 12.8963      | (99)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874  | 101.0011 | 204.8260  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 202.8526 | 114.7969 | 58.5937  | 14.3364  | 2.1931   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 19.0239  | 108.0225 | 219.0653  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299 | 132.9639 | 149.0014 | 156.8765 | 167.9858  | (64)   |
| Efficiency of water heater                                            | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (216)  |
| (217)m                                                                | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (217)  |
| Fuel for water heating, kWh/month                                     | 202.1030 | 180.8043 | 194.1085 | 178.2817 | 176.6798 | 158.8399 | 153.2170 | 167.2054 | 166.6215 | 184.3642 | 187.4837 | 196.8344  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2146.5434 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 246.3874  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3206.8153 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 738.8845           | 0.2160                        | 159.5991 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2146.5434          | 0.2160                        | 463.6534 (264)           |
| Space and water heating                                                                           |                    |                               | 623.2524 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 246.3874           | 0.5190                        | 127.8751 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 790.0525 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.6344 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3871 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7266 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.6344 * 1.00) + 2.3871 + 0.7266, rounded to 2 d.p. |                    |                               | 14.7500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000698                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_2_14.10_1B |                |            |
| Property                           | A_2_14.10_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.68        | TER            | 14.75      |
| Environmental                      | 91 B                                | % DER<TER     | 14.02        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.64                                | DFEE          | 21.41        | TFEE           | 22.97      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 6.82         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 54 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.75 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.68 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)23.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)21.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 13.51 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K              |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|----------------------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |             |                | 13.5100              | 0.9615           | 12.9904      |                   | (27)                       |         |         |         |         |              |
| External Wall 1                                                     | 21.6370     | 13.5120        | 8.1250               | 0.1600           | 1.3000       |                   | (29a)                      |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 21.6350              |                  |              |                   | (31)                       |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 14.2904      |                   | (33)                       |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 53.5700              |                  |              |                   | (32d)                      |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 53.5700              |                  |              |                   | (32b)                      |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 100.0000 (35)              |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   | (33) + (36) = 17.5356 (37) |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 11.5557     | 11.4272        | 11.2988              | 10.6566          | 10.5281      | 9.8859            | 9.8859                     | 9.7575  | 10.1428 | 10.5281 | 10.7850 | 11.0419 (38) |
| Heat transfer coeff                                                 | 29.0913     | 28.9629        | 28.8344              | 28.1922          | 28.0638      | 27.4216           | 27.4216                    | 27.2931 | 27.6784 | 28.0638 | 28.3207 | 28.5775 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |                            |         |         |         |         | 28.1601 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.5431      | 0.5407         | 0.5383               | 0.5263           | 0.5239       | 0.5119            | 0.5119                     | 0.5095  | 0.5167  | 0.5239  | 0.5287  | 0.5335 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |                            |         |         |         |         | 0.5257 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31                         | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |          |          | 1.7954 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |          |          | 76.8396 (43)                      |
| Daily hot water use                      | 84.5236  | 81.4500  | 78.3764  | 75.3028 | 72.2292 | 69.1556 | 69.1556 | 72.2292 | 75.3028 | 78.3764  | 81.4500  | 84.5236 (44)                      |
| Energy conte                             | 125.3460 | 109.6284 | 113.1267 | 98.6266 | 94.6346 | 81.6624 | 75.6723 | 86.8350 | 87.8721 | 102.4065 | 111.7847 | 121.3909 (45)                     |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         |          |          | Total = Sum(45)m = 1208.9861 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 18.8019  | 16.4443  | 16.9690  | 14.7940 | 14.1952 | 12.2494 | 11.3508 | 13.0253 | 13.1808 | 15.3610  | 16.7677  | 18.2086 (46)                      |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |          |          | 110.0000 (47)                     |
| Store volume                             |          |          |          |         |         |         |         |         |         |          |          |                                   |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 215.7325 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 226.5192 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1859.8258 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1952.8171 (310a) |
| Electricity used for heat distribution                                                  | 21.7934 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.7790 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.7790 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 246.3874 (332)   |
| Total delivered energy for all uses                                                     | 2511.5026 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2294.0382          | 0.2160                        | 495.5123 (367)           |
| Electrical energy for heat distribution                                                    | 21.7934            | 0.5190                        | 11.3108 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 506.8230 (373)           |
| Space and water heating                                                                    |                    |                               | 506.8230 (376)           |
| Pumps and fans                                                                             | 85.7790            | 0.5190                        | 44.5193 (378)            |
| Energy for lighting                                                                        | 246.3874           | 0.5190                        | 127.8751 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 679.2173 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.6800 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.6800 ZC1 |
| Total Floor Area                                                                | TFA | 53.5700     |
| Assumed number of occupants                                                     | N   | 1.7954      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.3109 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.0257 ZC3  |
| Total CO2 emissions                                                             |     | 33.0166 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 33.0166 ZC8 |



SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

|                                                      | main<br>heating              |   | secondary<br>heating |   | other |   | total                       | m3 per hour          |             |
|------------------------------------------------------|------------------------------|---|----------------------|---|-------|---|-----------------------------|----------------------|-------------|
| Number of chimneys                                   | 0                            | + | 0                    | + | 0     | = | 0 * 40 =                    | 0.0000               | (6a)        |
| Number of open flues                                 | 0                            | + | 0                    | + | 0     | = | 0 * 20 =                    | 0.0000               | (6b)        |
| Number of intermittent fans                          |                              |   |                      |   |       |   | 2 * 10 =                    | 20.0000              | (7a)        |
| Number of passive vents                              |                              |   |                      |   |       |   | 0 * 10 =                    | 0.0000               | (7b)        |
| Number of flueless gas fires                         |                              |   |                      |   |       |   | 0 * 40 =                    | 0.0000               | (7c)        |
|                                                      |                              |   |                      |   |       |   |                             | Air changes per hour |             |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |   |                      |   |       |   | 20.0000                     | / (5) =              | 0.1493 (8)  |
| Pressure test                                        |                              |   |                      |   |       |   | Yes                         |                      |             |
| Measured/design AP50                                 |                              |   |                      |   |       |   | 5.0000                      |                      |             |
| Infiltration rate                                    |                              |   |                      |   |       |   | 0.3993                      |                      | (18)        |
| Number of sides sheltered                            |                              |   |                      |   |       |   | 3                           |                      | (19)        |
| Shelter factor                                       |                              |   |                      |   |       |   | (20) = 1 - [0.075 x (19)] = |                      | 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor |                              |   |                      |   |       |   | (21) = (18) x (20) =        |                      | 0.3095 (21) |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3946 | 0.3869 | 0.3791 | 0.3404 | 0.3327 | 0.2940 | 0.2940 | 0.2863 | 0.3095 | 0.3327 | 0.3482 | 0.3636 (22b) |
| Effective ac    | 0.5779 | 0.5748 | 0.5719 | 0.5579 | 0.5553 | 0.5432 | 0.5432 | 0.5410 | 0.5479 | 0.5553 | 0.5606 | 0.5661 (25)  |

|                                                                     |             |                |               |                        |              |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------------|--------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K       | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 13.4000       | 1.3258                 | 17.7652      |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 21.6370     | 13.4000        | 8.2370        | 0.1800                 | 1.4827       |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 21.6370       |                        |              |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               | (26) ... (30) + (32) = | 19.2478      |                   |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                        |              |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal Bridges (User defined value 0.050 * total exposed area)     |             |                |               |                        |              |                   |               | 1.0819 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |               |                        |              | (33) + (36) =     | 20.3297       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                        |              |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar           | Apr                    | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 25.5383     | 25.4047        | 25.2738       | 24.6587                | 24.5436      | 24.0078           | 24.0078       | 23.9086       | 24.2142 | 24.5436 | 24.7764 | 25.0198 | (38) |
| Heat transfer coeff                                                 | 45.8680     | 45.7344        | 45.6034       | 44.9883                | 44.8732      | 44.3375           | 44.3375       | 44.2383       | 44.5438 | 44.8732 | 45.1060 | 45.3495 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                        |              |                   |               |               |         |         |         | 44.9878 | (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr                    | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.8562      | 0.8537         | 0.8513        | 0.8398                 | 0.8377       | 0.8277            | 0.8277        | 0.8258        | 0.8315  | 0.8377  | 0.8420  | 0.8465  | (40) |
| HLP (average)                                                       |             |                |               |                        |              |                   |               |               |         |         |         | 0.8398  | (40) |
| Days in month                                                       | 31          | 28             | 31            | 30                     | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

|                                                             |                    |          |          |         |         |         |         |         |         |          |          |                |
|-------------------------------------------------------------|--------------------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|----------------|
| Assumed occupancy                                           |                    |          |          |         |         |         |         |         |         |          |          | 1.7954 (42)    |
| Average daily hot water use (litres/day)                    |                    |          |          |         |         |         |         |         |         |          |          | 76.8396 (43)   |
|                                                             | Jan                | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec            |
| Daily hot water use                                         |                    |          |          |         |         |         |         |         |         |          |          |                |
|                                                             | 84.5236            | 81.4500  | 78.3764  | 75.3028 | 72.2292 | 69.1556 | 69.1556 | 72.2292 | 75.3028 | 78.3764  | 81.4500  | 84.5236 (44)   |
| Energy content (annual)                                     | 125.3460           | 109.6284 | 113.1267 | 98.6266 | 94.6346 | 81.6624 | 75.6723 | 86.8350 | 87.8721 | 102.4065 | 111.7847 | 121.3909 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                      | Total = Sum(45)m = |          |          |         |         |         |         |         |         |          |          | 1208.9861 (45) |
|                                                             | 18.8019            | 16.4443  | 16.9690  | 14.7940 | 14.1952 | 12.2494 | 11.3508 | 13.0253 | 13.1808 | 15.3610  | 16.7677  | 18.2086 (46)   |
| Water storage loss:                                         |                    |          |          |         |         |         |         |         |         |          |          |                |
| Store volume                                                |                    |          |          |         |         |         |         |         |         |          |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |                    |          |          |         |         |         |         |         |         |          |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |                    |          |          |         |         |         |         |         |         |          |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |                    |          |          |         |         |         |         |         |         |          |          | 0.7527 (55)    |
| Total storage loss                                          |                    |          |          |         |         |         |         |         |         |          |          |                |
|                                                             | 23.3325            | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325  | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |                    |          |          |         |         |         |         |         |         |          |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (64)  |
|                                                                 | 78.9535  | 70.1200  | 74.8905  | 68.8668  | 68.7419  | 63.2262  | 62.4369  | 66.1486                       | 65.2909     | 71.3261  | 73.2419  | 77.6384 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1757.6035 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9515  | 12.3916  | 10.0775  | 7.6293   | 5.7030   | 4.8147   | 5.2025   | 6.7624   | 9.0764   | 11.5246  | 13.4509  | 14.3392  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.4931 | 158.1170 | 154.0248 | 145.3130 | 134.3159 | 123.9802 | 117.0753 | 115.4514 | 119.5436 | 128.2554 | 139.2525 | 149.5882 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | (71) |
| Water heating gains (Table 5)                                                       | 106.1202 | 104.3453 | 100.6593 | 95.6484  | 92.3950  | 87.8142  | 83.9206  | 88.9094  | 90.6819  | 95.8684  | 101.7248 | 104.3527 | (72) |
| Total internal gains                                                                | 329.4951 | 327.7841 | 317.6919 | 301.5210 | 285.3442 | 269.5394 | 259.1287 | 264.0534 | 272.2322 | 288.5787 | 307.3585 | 321.2104 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|----------|---------------|
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |               |
| Southwest   |          |          |          | 13.4000    | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |          | 150.6786 (79) |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |               |
| Solar gains | 150.6786 | 256.6614 | 351.1754 | 435.1233   | 487.3744                       | 483.8500                          | 466.4830                           | 427.5014 | 380.2487 | 283.6656                     | 180.4783 | 128.9495 | (83)          |
| Total gains | 480.1737 | 584.4456 | 668.8673 | 736.6443   | 772.7186                       | 753.3894                          | 725.6117                           | 691.5548 | 652.4809 | 572.2443                     | 487.8368 | 450.1599 | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 81.1053 | 81.3423 | 81.5758 | 82.6912 | 82.9033 | 83.9051 | 83.9051 | 84.0932 | 83.5164                   | 82.9033 | 82.4754 | 82.0327 | (86)         |
| alpha                                                                       | 6.4070  | 6.4228  | 6.4384  | 6.5127  | 6.5269  | 6.5937  | 6.5937  | 6.6062  | 6.5678                    | 6.5269  | 6.4984  | 6.4688  |              |
| util living area                                                            | 0.9807  | 0.9430  | 0.8606  | 0.7090  | 0.5356  | 0.3763  | 0.2688  | 0.2942  | 0.4693                    | 0.7649  | 0.9487  | 0.9861  | (86)         |
| MIT                                                                         | 20.4534 | 20.6568 | 20.8412 | 20.9590 | 20.9935 | 20.9995 | 21.0000 | 20.9999 | 20.9978                   | 20.9461 | 20.6951 | 20.4100 | (87)         |
| Th 2                                                                        | 20.2049 | 20.2070 | 20.2091 | 20.2190 | 20.2208 | 20.2294 | 20.2294 | 20.2310 | 20.2261                   | 20.2208 | 20.2171 | 20.2132 | (88)         |
| util rest of house                                                          | 0.9755  | 0.9298  | 0.8346  | 0.6707  | 0.4923  | 0.3311  | 0.2218  | 0.2451  | 0.4174                    | 0.7210  | 0.9345  | 0.9823  | (89)         |
| MIT 2                                                                       | 19.4964 | 19.7819 | 20.0274 | 20.1778 | 20.2155 | 20.2291 | 20.2294 | 20.2310 | 20.2247                   | 20.1687 | 19.8477 | 19.4412 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5865  | (91)         |
| MIT                                                                         | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |              |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |       |
|                      | 0.9743   | 0.9314   | 0.8448   | 0.6915   | 0.5174   | 0.3576   | 0.2494   | 0.2739   | 0.4478   | 0.7443   | 0.9371   | 0.9811       | (94)  |
| Useful gains         | 467.8455 | 544.3568 | 565.0262 | 509.3631 | 399.8384 | 269.4162 | 180.9425 | 189.4011 | 292.1741 | 425.9310 | 457.1389 | 441.6446     | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)  |
| Heat loss rate W     | 722.7746 | 704.0817 | 638.6621 | 527.9805 | 402.5945 | 269.6139 | 180.9569 | 189.4276 | 293.0165 | 449.8388 | 597.4181 | 716.9484     | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a) |
| Space heating kWh    | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874  | 101.0011 | 204.8260     | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 690.8570     | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 12.8963      | (99)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874  | 101.0011 | 204.8260  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 202.8526 | 114.7969 | 58.5937  | 14.3364  | 2.1931   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 19.0239  | 108.0225 | 219.0653  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299 | 132.9639 | 149.0014 | 156.8765 | 167.9858  | (64)   |
| Efficiency of water heater                                            | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (216)  |
| (217)m                                                                | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (217)  |
| Fuel for water heating, kWh/month                                     | 202.1030 | 180.8043 | 194.1085 | 178.2817 | 176.6798 | 158.8399 | 153.2170 | 167.2054 | 166.6215 | 184.3642 | 187.4837 | 196.8344  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2146.5434 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 246.3874  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3206.8153 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 738.8845           | 0.2160                        | 159.5991 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2146.5434          | 0.2160                        | 463.6534 (264)           |
| Space and water heating                                                                           |                    |                               | 623.2524 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 246.3874           | 0.5190                        | 127.8751 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 790.0525 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.6344 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3871 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7266 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.6344 * 1.00) + 2.3871 + 0.7266, rounded to 2 d.p. |                    |                               | 14.7500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000726                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.11_1B |                |            |
| Property                           | A_1_14.11_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.03        | TER            | 14.75      |
| Environmental                      | 90 B                                | % DER<TER     | 4.87         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.68                                | DFEE          | 28.37        | TFEE           | 22.97      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -23.48       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 54 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.75 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.03 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)23.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)28.4 kWh/m<sup>2</sup>/yrFail  
Excess energy =5.4 kWh/m<sup>2</sup>/yr (23.5%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                           |                          |   |
|---------------------------|--------------------------|---|
| Main heating system:      | Community heating scheme | - |
| Secondary heating system: | None                     |   |

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                    |      |
|-----------------------------------|------------------------------------|------|
| Overheating risk (Thames Valley): | High                               | Fail |
| Based on:                         |                                    |      |
| Overshading:                      | Average                            |      |
| Windows facing South West:        | 13.51 m <sup>2</sup> , No overhang |      |
| Air change rate:                  | 2.00 ach                           |      |
| Blinds/curtains:                  | None                               |      |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K              |               |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------------------|---------------|----------------|----------------|----------------|---------------------|
| Opening Type 1 (Uw = 1.40)                                          |                |                | 13.5100              | 1.3258           | 17.9110        |                   | (27)                       |               |                |                |                |                     |
| External Wall 1                                                     | 21.6370        | 13.5120        | 8.1250               | 0.1600           | 1.3000         |                   | (29a)                      |               |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 21.6350              |                  |                |                   | (31)                       |               |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 19.2110        |                   | (33)                       |               |                |                |                |                     |
| Party Floor 1                                                       |                |                | 53.5700              |                  |                |                   | (32d)                      |               |                |                |                |                     |
| Party Ceilings 1                                                    |                |                | 53.5700              |                  |                |                   | (32b)                      |               |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| Thermal bridges (Default value 0.150 * total exposed area)          |                |                |                      |                  |                |                   | 100.0000 (35)              |               |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                |                   | (33) + (36) = 22.4562 (37) |               |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| (38)m                                                               | Jan<br>11.5557 | Feb<br>11.4272 | Mar<br>11.2988       | Apr<br>10.6566   | May<br>10.5281 | Jun<br>9.8859     | Jul<br>9.8859              | Aug<br>9.7575 | Sep<br>10.1428 | Oct<br>10.5281 | Nov<br>10.7850 | Dec<br>11.0419 (38) |
| Heat transfer coeff                                                 | 34.0119        | 33.8835        | 33.7550              | 33.1128          | 32.9844        | 32.3422           | 32.3422                    | 32.2137       | 32.5990        | 32.9844        | 33.2413        | 33.4981 (39)        |
| Average = Sum(39)m / 12 =                                           | 33.0807 (39)   |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| HLP                                                                 | Jan<br>0.6349  | Feb<br>0.6325  | Mar<br>0.6301        | Apr<br>0.6181    | May<br>0.6157  | Jun<br>0.6037     | Jul<br>0.6037              | Aug<br>0.6013 | Sep<br>0.6085  | Oct<br>0.6157  | Nov<br>0.6205  | Dec<br>0.6253 (40)  |
| HLP (average)                                                       | 0.6175 (40)    |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31                         | 31            | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |          |          | 1.7954 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |          |          | 76.8396 (43)                      |
| Daily hot water use                      | 84.5236  | 81.4500  | 78.3764  | 75.3028 | 72.2292 | 69.1556 | 69.1556 | 72.2292 | 75.3028 | 78.3764  | 81.4500  | 84.5236 (44)                      |
| Energy conte                             | 125.3460 | 109.6284 | 113.1267 | 98.6266 | 94.6346 | 81.6624 | 75.6723 | 86.8350 | 87.8721 | 102.4065 | 111.7847 | 121.3909 (45)                     |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         |          |          | Total = Sum(45)m = 1208.9861 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 18.8019  | 16.4443  | 16.9690  | 14.7940 | 14.1952 | 12.2494 | 11.3508 | 13.0253 | 13.1808 | 15.3610  | 16.7677  | 18.2086 (46)                      |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |          |          | 110.0000 (47)                     |
| Store volume                             |          |          |          |         |         |         |         |         |         |          |          |                                   |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)    |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)   |
| Primary loss                                                    |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 180.6228 | 159.5558 | 168.4035 | 152.1203 | 149.9114 | 135.1561 | 130.9491 | 142.1118 | 141.3658 | 157.6833 | 165.2783 | 176.6677 (62)  |
| Solar input                                                     |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 180.6228 | 159.5558 | 168.4035 | 152.1203 | 149.9114 | 135.1561 | 130.9491 | 142.1118 | 141.3658 | 157.6833 | 165.2783 | 176.6677 (64)  |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 1859.8258 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                 | 85.8990  | 76.3934  | 81.8361  | 75.5883  | 75.6874  | 69.9477  | 69.3825  | 73.0941  | 72.0124  | 78.2716  | 79.9633  | 84.5839 (65)   |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9515  | 12.3916  | 10.0775  | 7.6293   | 5.7030   | 4.8147   | 5.2025   | 6.7624   | 9.0764   | 11.5246  | 13.4509  | 14.3392 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.4931 | 158.1170 | 154.0248 | 145.3130 | 134.3159 | 123.9802 | 117.0753 | 115.4514 | 119.5436 | 128.2554 | 139.2525 | 149.5882 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 (71) |
| Water heating gains (Table 5)                                                       | 115.4556 | 113.6806 | 109.9947 | 104.9837 | 101.7304 | 97.1496  | 93.2560  | 98.2447  | 100.0172 | 105.2038 | 111.0602 | 113.6881 (72) |
| Total internal gains                                                                | 335.8305 | 334.1195 | 324.0273 | 307.8563 | 291.6796 | 275.8748 | 265.4641 | 270.3888 | 278.5676 | 294.9141 | 313.6939 | 327.5458 (73) |

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|
| Southwest   |          |          |          | 13.5120    | 36.7938                        |          | 0.3000                            |          | 0.8000                             |          | 0.7700                       |          | 82.6874 (79) |
| Solar gains | 82.6874  | 140.8472 | 192.7132 | 238.7810   | 267.4547                       | 265.5206 | 255.9902                          | 234.5984 | 208.6677                           | 155.6661 | 99.0404                      | 70.7632  | (83)         |
| Total gains | 418.5178 | 474.9667 | 516.7405 | 546.6374   | 559.1343                       | 541.3954 | 521.4542                          | 504.9872 | 487.2352                           | 450.5802 | 412.7343                     | 398.3089 | (84)         |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 43.7510 | 43.9169 | 44.0840 | 44.9390 | 45.1140 | 46.0098 | 46.0098 | 46.1932 | 45.6472                   | 45.1140 | 44.7653 | 44.4220      |
| alpha                                                                       | 3.9167  | 3.9278  | 3.9389  | 3.9959  | 4.0076  | 4.0673  | 4.0673  | 4.0795  | 4.0431                    | 4.0076  | 3.9844  | 3.9615       |
| util living area                                                            | 0.8976  | 0.8482  | 0.7753  | 0.6612  | 0.5251  | 0.3776  | 0.2719  | 0.2920  | 0.4505                    | 0.6795  | 0.8418  | 0.9094 (86)  |
| MIT                                                                         | 20.2192 | 20.4204 | 20.6388 | 20.8396 | 20.9462 | 20.9894 | 20.9978 | 20.9971 | 20.9777                   | 20.8492 | 20.5319 | 20.1825 (87) |
| Th 2                                                                        | 20.3987 | 20.4008 | 20.4030 | 20.4137 | 20.4159 | 20.4266 | 20.4266 | 20.4288 | 20.4223                   | 20.4159 | 20.4116 | 20.4073 (88) |
| util rest of house                                                          | 0.8878  | 0.8351  | 0.7574  | 0.6375  | 0.4962  | 0.3450  | 0.2368  | 0.2563  | 0.4154                    | 0.6521  | 0.8262  | 0.9005 (89)  |
| MIT 2                                                                       | 19.3523 | 19.6355 | 19.9389 | 20.2176 | 20.3555 | 20.4165 | 20.4250 | 20.4265 | 20.4000                   | 20.2363 | 19.8044 | 19.3074 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5865 (91)  |
| MIT                                                                         | 19.8608 | 20.0958 | 20.3494 | 20.5824 | 20.7020 | 20.7525 | 20.7612 | 20.7612 | 20.7388                   | 20.5958 | 20.2311 | 19.8207 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.8608 | 20.0958 | 20.3494 | 20.5824 | 20.7020 | 20.7525 | 20.7610 | 20.7612 | 20.7388                   | 20.5958 | 20.2311 | 19.8207 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8782   | 0.8279   | 0.7558   | 0.6445   | 0.5105   | 0.3636   | 0.2573   | 0.2771   | 0.4347   | 0.6607       | 0.8211   | 0.8908 (94)   |
| Useful gains         | 367.5217 | 393.2260 | 390.5346 | 352.2984 | 285.4203 | 196.8246 | 134.1703 | 139.9401 | 211.8215 | 297.7113     | 338.8951 | 354.8013 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 529.2524 | 514.8872 | 467.4864 | 386.8384 | 296.9245 | 198.9851 | 134.5751 | 140.4896 | 216.4195 | 329.7038     | 436.4934 | 523.2639 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 120.3276 | 81.7563  | 57.2521  | 24.8688  | 8.5592   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 23.8024      | 70.2708  | 125.3362 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 512.1734 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 9.5608 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 512.1734 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 537.7820 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1859.8258 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1952.8171 (310a) |
| Electricity used for heat distribution                                                  | 24.9060 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.7790 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.7790 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 246.3874 (332)   |
| Total delivered energy for all uses                                                     | 2822.7655 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2621.6833          | 0.2160                        | 566.2836 (367)           |
| Electrical energy for heat distribution                                                    | 24.9060            | 0.5190                        | 12.9262 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 579.2098 (373)           |
| Space and water heating                                                                    |                    |                               | 579.2098 (376)           |
| Pumps and fans                                                                             | 85.7790            | 0.5190                        | 44.5193 (378)            |
| Energy for lighting                                                                        | 246.3874           | 0.5190                        | 127.8751 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 751.6041 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.0300 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 14.0300 ZC1 |
| Total Floor Area                                                                | TFA | 53.5700     |
| Assumed number of occupants                                                     | N   | 1.7954      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.3109 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.0257 ZC3  |
| Total CO2 emissions                                                             |     | 34.3666 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 34.3666 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1493 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3993 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3095 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3946 | 0.3869 | 0.3791 | 0.3404 | 0.3327 | 0.2940 | 0.2940 | 0.2863 | 0.3095 | 0.3327 | 0.3482 | 0.3636 (22b) |
| Effective ac    | 0.5779 | 0.5748 | 0.5719 | 0.5579 | 0.5553 | 0.5432 | 0.5432 | 0.5410 | 0.5479 | 0.5553 | 0.5606 | 0.5661 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 13.4000                   | 1.3258                        | 17.7652      |                                | (27)          |
| External Wall 1                                                     | 21.6370                 | 13.4000                    | 8.2370                    | 0.1800                        | 1.4827       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 21.6370                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 19.2478      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.0819 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 20.3297 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 25.5383                 | 25.4047                    | 25.2738                   | 24.6587                       | 24.5436      | 24.0078                        | 24.0078       |
| Heat transfer coeff                                                 | 45.8680                 | 45.7344                    | 45.6034                   | 44.9883                       | 44.8732      | 44.3375                        | 44.3375       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| HLP                                                                 | 0.8562                  | 0.8537                     | 0.8513                    | 0.8398                        | 0.8377       | 0.8277                         | 0.8277        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                | 0.8258        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              |                                | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7954 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 76.8396 (43)   |
| Daily hot water use                                         | 84.5236  | 81.4500  | 78.3764  | 75.3028 | 72.2292 | 69.1556 | 69.1556 | 72.2292 | 75.3028 | 78.3764            | 81.4500  | 84.5236 (44)   |
| Energy conte                                                | 125.3460 | 109.6284 | 113.1267 | 98.6266 | 94.6346 | 81.6624 | 75.6723 | 86.8350 | 87.8721 | 102.4065           | 111.7847 | 121.3909 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1208.9861 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.8019  | 16.4443  | 16.9690  | 14.7940 | 14.1952 | 12.2494 | 11.3508 | 13.0253 | 13.1808 | 15.3610            | 16.7677  | 18.2086 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (64)  |
|                                                                 | 78.9535  | 70.1200  | 74.8905  | 68.8668  | 68.7419  | 63.2262  | 62.4369  | 66.1486                       | 65.2909     | 71.3261  | 73.2419  | 77.6384 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1757.6035 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9515  | 12.3916  | 10.0775  | 7.6293   | 5.7030   | 4.8147   | 5.2025   | 6.7624   | 9.0764   | 11.5246  | 13.4509  | 14.3392  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.4931 | 158.1170 | 154.0248 | 145.3130 | 134.3159 | 123.9802 | 117.0753 | 115.4514 | 119.5436 | 128.2554 | 139.2525 | 149.5882 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | (71) |
| Water heating gains (Table 5)                                                       | 106.1202 | 104.3453 | 100.6593 | 95.6484  | 92.3950  | 87.8142  | 83.9206  | 88.9094  | 90.6819  | 95.8684  | 101.7248 | 104.3527 | (72) |
| Total internal gains                                                                | 329.4951 | 327.7841 | 317.6919 | 301.5210 | 285.3442 | 269.5394 | 259.1287 | 264.0534 | 272.2322 | 288.5787 | 307.3585 | 321.2104 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|----------|---------------|
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |               |
| Southwest   |          |          |          | 13.4000    | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |          | 150.6786 (79) |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |               |
| Solar gains | 150.6786 | 256.6614 | 351.1754 | 435.1233   | 487.3744                       | 483.8500                          | 466.4830                           | 427.5014 | 380.2487 | 283.6656                     | 180.4783 | 128.9495 | (83)          |
| Total gains | 480.1737 | 584.4456 | 668.8673 | 736.6443   | 772.7186                       | 753.3894                          | 725.6117                           | 691.5548 | 652.4809 | 572.2443                     | 487.8368 | 450.1599 | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 81.1053 | 81.3423 | 81.5758 | 82.6912 | 82.9033 | 83.9051 | 83.9051 | 84.0932 | 83.5164                   | 82.9033 | 82.4754 | 82.0327 | (86)         |
| alpha                                                                       | 6.4070  | 6.4228  | 6.4384  | 6.5127  | 6.5269  | 6.5937  | 6.5937  | 6.6062  | 6.5678                    | 6.5269  | 6.4984  | 6.4688  |              |
| util living area                                                            | 0.9807  | 0.9430  | 0.8606  | 0.7090  | 0.5356  | 0.3763  | 0.2688  | 0.2942  | 0.4693                    | 0.7649  | 0.9487  | 0.9861  | (86)         |
| MIT                                                                         | 20.4534 | 20.6568 | 20.8412 | 20.9590 | 20.9935 | 20.9995 | 21.0000 | 20.9999 | 20.9978                   | 20.9461 | 20.6951 | 20.4100 | (87)         |
| Th 2                                                                        | 20.2049 | 20.2070 | 20.2091 | 20.2190 | 20.2208 | 20.2294 | 20.2294 | 20.2310 | 20.2261                   | 20.2208 | 20.2171 | 20.2132 | (88)         |
| util rest of house                                                          | 0.9755  | 0.9298  | 0.8346  | 0.6707  | 0.4923  | 0.3311  | 0.2218  | 0.2451  | 0.4174                    | 0.7210  | 0.9345  | 0.9823  | (89)         |
| MIT 2                                                                       | 19.4964 | 19.7819 | 20.0274 | 20.1778 | 20.2155 | 20.2291 | 20.2294 | 20.2310 | 20.2247                   | 20.1687 | 19.8477 | 19.4412 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5865  | (91)         |
| MIT                                                                         | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |              |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |       |
|                      | 0.9743   | 0.9314   | 0.8448   | 0.6915   | 0.5174   | 0.3576   | 0.2494   | 0.2739   | 0.4478   | 0.7443   | 0.9371   | 0.9811       | (94)  |
| Useful gains         | 467.8455 | 544.3568 | 565.0262 | 509.3631 | 399.8384 | 269.4162 | 180.9425 | 189.4011 | 292.1741 | 425.9310 | 457.1389 | 441.6446     | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)  |
| Heat loss rate W     | 722.7746 | 704.0817 | 638.6621 | 527.9805 | 402.5945 | 269.6139 | 180.9569 | 189.4276 | 293.0165 | 449.8388 | 597.4181 | 716.9484     | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a) |
| Space heating kWh    | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874  | 101.0011 | 204.8260     | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 690.8570     | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 12.8963      | (99)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874  | 101.0011 | 204.8260  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 202.8526 | 114.7969 | 58.5937  | 14.3364  | 2.1931   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 19.0239  | 108.0225 | 219.0653  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299 | 132.9639 | 149.0014 | 156.8765 | 167.9858  | (64)   |
| Efficiency of water heater                                            | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (216)  |
| (217)m                                                                | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (217)  |
| Fuel for water heating, kWh/month                                     | 202.1030 | 180.8043 | 194.1085 | 178.2817 | 176.6798 | 158.8399 | 153.2170 | 167.2054 | 166.6215 | 184.3642 | 187.4837 | 196.8344  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2146.5434 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 246.3874  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3206.8153 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 738.8845           | 0.2160                        | 159.5991 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2146.5434          | 0.2160                        | 463.6534 (264)           |
| Space and water heating                                                                           |                    |                               | 623.2524 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 246.3874           | 0.5190                        | 127.8751 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 790.0525 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.6344 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3871 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7266 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.6344 * 1.00) + 2.3871 + 0.7266, rounded to 2 d.p. |                    |                               | 14.7500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000770                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.11_1B |                |            |
| Property                           | A_1_14.11_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.68        | TER            | 14.75      |
| Environmental                      | 91 B                                | % DER<TER     | 14.02        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.64                                | DFEE          | 21.41        | TFEE           | 22.97      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 6.82         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 54 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.75 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.68 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)23.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)21.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 13.51 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K              |               |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------------------|---------------|----------------|----------------|----------------|---------------------|
| Opening Type 1 (Uw = 1.00)                                          |                |                | 13.5100              | 0.9615           | 12.9904        |                   | (27)                       |               |                |                |                |                     |
| External Wall 1                                                     | 21.6370        | 13.5120        | 8.1250               | 0.1600           | 1.3000         |                   | (29a)                      |               |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 21.6350              |                  |                |                   | (31)                       |               |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 14.2904        |                   | (33)                       |               |                |                |                |                     |
| Party Floor 1                                                       |                |                | 53.5700              |                  |                |                   | (32d)                      |               |                |                |                |                     |
| Party Ceilings 1                                                    |                |                | 53.5700              |                  |                |                   | (32b)                      |               |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| Thermal bridges (Default value 0.150 * total exposed area)          |                |                |                      |                  |                |                   | 100.0000 (35)              |               |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                |                   | (33) + (36) = 17.5356 (37) |               |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| (38)m                                                               | Jan<br>11.5557 | Feb<br>11.4272 | Mar<br>11.2988       | Apr<br>10.6566   | May<br>10.5281 | Jun<br>9.8859     | Jul<br>9.8859              | Aug<br>9.7575 | Sep<br>10.1428 | Oct<br>10.5281 | Nov<br>10.7850 | Dec<br>11.0419 (38) |
| Heat transfer coeff                                                 | 29.0913        | 28.9629        | 28.8344              | 28.1922          | 28.0638        | 27.4216           | 27.4216                    | 27.2931       | 27.6784        | 28.0638        | 28.3207        | 28.5775 (39)        |
| Average = Sum(39)m / 12 =                                           | 28.1601 (39)   |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| HLP                                                                 | Jan<br>0.5431  | Feb<br>0.5407  | Mar<br>0.5383        | Apr<br>0.5263    | May<br>0.5239  | Jun<br>0.5119     | Jul<br>0.5119              | Aug<br>0.5095 | Sep<br>0.5167  | Oct<br>0.5239  | Nov<br>0.5287  | Dec<br>0.5335 (40)  |
| HLP (average)                                                       | 0.5257 (40)    |                |                      |                  |                |                   |                            |               |                |                |                |                     |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31                         | 31            | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |          |          | 1.7954 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |          |          | 76.8396 (43)                      |
| Daily hot water use                      | 84.5236  | 81.4500  | 78.3764  | 75.3028 | 72.2292 | 69.1556 | 69.1556 | 72.2292 | 75.3028 | 78.3764  | 81.4500  | 84.5236 (44)                      |
| Energy conte                             | 125.3460 | 109.6284 | 113.1267 | 98.6266 | 94.6346 | 81.6624 | 75.6723 | 86.8350 | 87.8721 | 102.4065 | 111.7847 | 121.3909 (45)                     |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         |          |          | Total = Sum(45)m = 1208.9861 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 18.8019  | 16.4443  | 16.9690  | 14.7940 | 14.1952 | 12.2494 | 11.3508 | 13.0253 | 13.1808 | 15.3610  | 16.7677  | 18.2086 (46)                      |
| Water storage loss:                      |          |          |          |         |         |         |         |         |         |          |          | 110.0000 (47)                     |
| Store volume                             |          |          |          |         |         |         |         |         |         |          |          |                                   |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 180.6228 | 159.5558 | 168.4035 | 152.1203 | 149.9114 | 135.1561 | 130.9491 | 142.1118                                 | 141.3658 | 157.6833 | 165.2783 | 176.6677 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 | 180.6228 | 159.5558 | 168.4035 | 152.1203 | 149.9114 | 135.1561 | 130.9491 | 142.1118                                 | 141.3658 | 157.6833 | 165.2783 | 176.6677 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 1859.8258 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 85.8990  | 76.3934  | 81.8361  | 75.5883  | 75.6874  | 69.9477  | 69.3825  | 73.0941                                  | 72.0124  | 78.2716  | 79.9633  | 84.5839 (65)  |                |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 215.7325 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 226.5192 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1859.8258 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1952.8171 (310a) |
| Electricity used for heat distribution                                                  | 21.7934 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.7790 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.7790 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 246.3874 (332)   |
| Total delivered energy for all uses                                                     | 2511.5026 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2294.0382          | 0.2160                        | 495.5123 (367)           |
| Electrical energy for heat distribution                                                    | 21.7934            | 0.5190                        | 11.3108 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 506.8230 (373)           |
| Space and water heating                                                                    |                    |                               | 506.8230 (376)           |
| Pumps and fans                                                                             | 85.7790            | 0.5190                        | 44.5193 (378)            |
| Energy for lighting                                                                        | 246.3874           | 0.5190                        | 127.8751 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 679.2173 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.6800 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.6800 ZC1 |
| Total Floor Area                                                                | TFA | 53.5700     |
| Assumed number of occupants                                                     | N   | 1.7954      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.3109 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.0257 ZC3  |
| Total CO2 emissions                                                             |     | 33.0166 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 33.0166 ZC8 |



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|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.5700 (1b)              | x 2.5000 (2b)                   | = 133.9250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.5700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.9250 (5)              |

|                                                      | main<br>heating              |   | secondary<br>heating |   | other |   | total                       | m3 per hour |      |
|------------------------------------------------------|------------------------------|---|----------------------|---|-------|---|-----------------------------|-------------|------|
| Number of chimneys                                   | 0                            | + | 0                    | + | 0     | = | 0 * 40 =                    | 0.0000      | (6a) |
| Number of open flues                                 | 0                            | + | 0                    | + | 0     | = | 0 * 20 =                    | 0.0000      | (6b) |
| Number of intermittent fans                          |                              |   |                      |   |       |   | 2 * 10 =                    | 20.0000     | (7a) |
| Number of passive vents                              |                              |   |                      |   |       |   | 0 * 10 =                    | 0.0000      | (7b) |
| Number of flueless gas fires                         |                              |   |                      |   |       |   | 0 * 40 =                    | 0.0000      | (7c) |
| Air changes per hour                                 |                              |   |                      |   |       |   |                             |             |      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |   |                      |   |       |   | 20.0000 / (5) =             | 0.1493      | (8)  |
| Pressure test                                        |                              |   |                      |   |       |   | Yes                         |             |      |
| Measured/design AP50                                 |                              |   |                      |   |       |   | 5.0000                      |             |      |
| Infiltration rate                                    |                              |   |                      |   |       |   |                             | 0.3993      | (18) |
| Number of sides sheltered                            |                              |   |                      |   |       |   |                             | 3           | (19) |
| Shelter factor                                       |                              |   |                      |   |       |   | (20) = 1 - [0.075 x (19)] = | 0.7750      | (20) |
| Infiltration rate adjusted to include shelter factor |                              |   |                      |   |       |   | (21) = (18) x (20) =        | 0.3095      | (21) |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3946 | 0.3869 | 0.3791 | 0.3404 | 0.3327 | 0.2940 | 0.2940 | 0.2863 | 0.3095 | 0.3327 | 0.3482 | 0.3636 (22b) |
| Effective ac    | 0.5779 | 0.5748 | 0.5719 | 0.5579 | 0.5553 | 0.5432 | 0.5432 | 0.5410 | 0.5479 | 0.5553 | 0.5606 | 0.5661 (25)  |

|                                                                     |             |                |               |                        |              |                   |               |               |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------------|--------------|-------------------|---------------|---------------|---------|---------|---------|--------------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K       | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |              |
| TER Opening Type (Uw = 1.40)                                        |             |                | 13.4000       | 1.3258                 | 17.7652      |                   |               | (27)          |         |         |         |              |
| External Wall 1                                                     | 21.6370     | 13.4000        | 8.2370        | 0.1800                 | 1.4827       |                   |               | (29a)         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 21.6370       |                        |              |                   |               | (31)          |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               | (26) ... (30) + (32) = | 19.2478      |                   |               | (33)          |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                        |              |                   |               | 250.0000 (35) |         |         |         |              |
| Thermal Bridges (User defined value 0.050 * total exposed area)     |             |                |               |                        |              |                   |               | 1.0819 (36)   |         |         |         |              |
| Total fabric heat loss                                              |             |                |               |                        |              | (33) + (36) =     | 20.3297       | (37)          |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                        |              |                   |               |               |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar           | Apr                    | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 25.5383     | 25.4047        | 25.2738       | 24.6587                | 24.5436      | 24.0078           | 24.0078       | 23.9086       | 24.2142 | 24.5436 | 24.7764 | 25.0198 (38) |
| Heat transfer coeff                                                 | 45.8680     | 45.7344        | 45.6034       | 44.9883                | 44.8732      | 44.3375           | 44.3375       | 44.2383       | 44.5438 | 44.8732 | 45.1060 | 45.3495 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                        |              |                   |               |               |         |         |         | 44.9878 (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr                    | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.8562      | 0.8537         | 0.8513        | 0.8398                 | 0.8377       | 0.8277            | 0.8277        | 0.8258        | 0.8315  | 0.8377  | 0.8420  | 0.8465 (40)  |
| HLP (average)                                                       |             |                |               |                        |              |                   |               |               |         |         |         | 0.8398 (40)  |
| Days in month                                                       | 31          | 28             | 31            | 30                     | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31 (41)      |

|                                                             |                    |          |          |         |         |         |         |         |         |          |          |                |
|-------------------------------------------------------------|--------------------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|----------------|
| Assumed occupancy                                           |                    |          |          |         |         |         |         |         |         |          |          | 1.7954 (42)    |
| Average daily hot water use (litres/day)                    |                    |          |          |         |         |         |         |         |         |          |          | 76.8396 (43)   |
|                                                             | Jan                | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec            |
| Daily hot water use                                         |                    |          |          |         |         |         |         |         |         |          |          |                |
|                                                             | 84.5236            | 81.4500  | 78.3764  | 75.3028 | 72.2292 | 69.1556 | 69.1556 | 72.2292 | 75.3028 | 78.3764  | 81.4500  | 84.5236 (44)   |
| Energy content (annual)                                     | 125.3460           | 109.6284 | 113.1267 | 98.6266 | 94.6346 | 81.6624 | 75.6723 | 86.8350 | 87.8721 | 102.4065 | 111.7847 | 121.3909 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                      | Total = Sum(45)m = |          |          |         |         |         |         |         |         |          |          | 1208.9861 (45) |
|                                                             | 18.8019            | 16.4443  | 16.9690  | 14.7940 | 14.1952 | 12.2494 | 11.3508 | 13.0253 | 13.1808 | 15.3610  | 16.7677  | 18.2086 (46)   |
| Water storage loss:                                         |                    |          |          |         |         |         |         |         |         |          |          |                |
| Store volume                                                |                    |          |          |         |         |         |         |         |         |          |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |                    |          |          |         |         |         |         |         |         |          |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |                    |          |          |         |         |         |         |         |         |          |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |                    |          |          |         |         |         |         |         |         |          |          | 0.7527 (55)    |
| Total storage loss                                          |                    |          |          |         |         |         |         |         |         |          |          |                |
|                                                             | 23.3325            | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325  | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |                    |          |          |         |         |         |         |         |         |          |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299                      | 132.9639    | 149.0014 | 156.8765 | 167.9858 (64)  |
|                                                                 | 78.9535  | 70.1200  | 74.8905  | 68.8668  | 68.7419  | 63.2262  | 62.4369  | 66.1486                       | 65.2909     | 71.3261  | 73.2419  | 77.6384 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1757.6035 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | 89.7676  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9515  | 12.3916  | 10.0775  | 7.6293   | 5.7030   | 4.8147   | 5.2025   | 6.7624   | 9.0764   | 11.5246  | 13.4509  | 14.3392  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.4931 | 158.1170 | 154.0248 | 145.3130 | 134.3159 | 123.9802 | 117.0753 | 115.4514 | 119.5436 | 128.2554 | 139.2525 | 149.5882 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | 31.9768  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | -71.8141 | (71) |
| Water heating gains (Table 5)                                                       | 106.1202 | 104.3453 | 100.6593 | 95.6484  | 92.3950  | 87.8142  | 83.9206  | 88.9094  | 90.6819  | 95.8684  | 101.7248 | 104.3527 | (72) |
| Total internal gains                                                                | 329.4951 | 327.7841 | 317.6919 | 301.5210 | 285.3442 | 269.5394 | 259.1287 | 264.0534 | 272.2322 | 288.5787 | 307.3585 | 321.2104 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |          |      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|----------|------|
| -----       |          |          |          | Southwest  | 13.4000                        | 36.7938                           | 0.6300                             | 0.7000   | 0.7700   |                              | 150.6786 (79) |          |      |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |               |          |      |
| Solar gains | 150.6786 | 256.6614 | 351.1754 | 435.1233   | 487.3744                       | 483.8500                          | 466.4830                           | 427.5014 | 380.2487 | 283.6656                     | 180.4783      | 128.9495 | (83) |
| Total gains | 480.1737 | 584.4456 | 668.8673 | 736.6443   | 772.7186                       | 753.3894                          | 725.6117                           | 691.5548 | 652.4809 | 572.2443                     | 487.8368      | 450.1599 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 81.1053 | 81.3423 | 81.5758 | 82.6912 | 82.9033 | 83.9051 | 83.9051 | 84.0932 | 83.5164                   | 82.9033 | 82.4754 | 82.0327 | (86)         |
| alpha                                                                       | 6.4070  | 6.4228  | 6.4384  | 6.5127  | 6.5269  | 6.5937  | 6.5937  | 6.6062  | 6.5678                    | 6.5269  | 6.4984  | 6.4688  |              |
| util living area                                                            | 0.9807  | 0.9430  | 0.8606  | 0.7090  | 0.5356  | 0.3763  | 0.2688  | 0.2942  | 0.4693                    | 0.7649  | 0.9487  | 0.9861  | (86)         |
| MIT                                                                         | 20.4534 | 20.6568 | 20.8412 | 20.9590 | 20.9935 | 20.9995 | 21.0000 | 20.9999 | 20.9978                   | 20.9461 | 20.6951 | 20.4100 | (87)         |
| Th 2                                                                        | 20.2049 | 20.2070 | 20.2091 | 20.2190 | 20.2208 | 20.2294 | 20.2294 | 20.2310 | 20.2261                   | 20.2208 | 20.2171 | 20.2132 | (88)         |
| util rest of house                                                          | 0.9755  | 0.9298  | 0.8346  | 0.6707  | 0.4923  | 0.3311  | 0.2218  | 0.2451  | 0.4174                    | 0.7210  | 0.9345  | 0.9823  | (89)         |
| MIT 2                                                                       | 19.4964 | 19.7819 | 20.0274 | 20.1778 | 20.2155 | 20.2291 | 20.2294 | 20.2310 | 20.2247                   | 20.1687 | 19.8477 | 19.4412 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5865  | (91)         |
| MIT                                                                         | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0577 | 20.2950 | 20.5047 | 20.6359 | 20.6718 | 20.6809 | 20.6814 | 20.6820 | 20.6782                   | 20.6247 | 20.3447 | 20.0094 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec      |       |
|                      | 0.9743   | 0.9314   | 0.8448   | 0.6915   | 0.5174   | 0.3576   | 0.2494   | 0.2739   | 0.4478   | 0.7443       | 0.9371   | 0.9811   | (94)  |
| Useful gains         | 467.8455 | 544.3568 | 565.0262 | 509.3631 | 399.8384 | 269.4162 | 180.9425 | 189.4011 | 292.1741 | 425.9310     | 457.1389 | 441.6446 | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000   | (96)  |
| Heat loss rate W     | 722.7746 | 704.0817 | 638.6621 | 527.9805 | 402.5945 | 269.6139 | 180.9569 | 189.4276 | 293.0165 | 449.8388     | 597.4181 | 716.9484 | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000   | (97a) |
| Space heating kWh    | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874      | 101.0011 | 204.8260 | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 690.8570 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 12.8963  | (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |          |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

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|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 189.6672 | 107.3351 | 54.7851  | 13.4046  | 2.0506   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.7874  | 101.0011 | 204.8260  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 202.8526 | 114.7969 | 58.5937  | 14.3364  | 2.1931   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 19.0239  | 108.0225 | 219.0653  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 171.9409 | 151.7141 | 159.7216 | 143.7184 | 141.2295 | 126.7543 | 122.2672 | 133.4299 | 132.9639 | 149.0014 | 156.8765 | 167.9858  | (64)   |
| Efficiency of water heater                                            | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (216)  |
| (217)m                                                                | 85.0759  | 83.9107  | 82.2847  | 80.6131  | 79.9353  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8190  | 83.6747  | 85.3437   | (217)  |
| Fuel for water heating, kWh/month                                     | 202.1030 | 180.8043 | 194.1085 | 178.2817 | 176.6798 | 158.8399 | 153.2170 | 167.2054 | 166.6215 | 184.3642 | 187.4837 | 196.8344  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2146.5434 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 738.8845  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 246.3874  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3206.8153 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 738.8845           | 0.2160                        | 159.5991 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2146.5434          | 0.2160                        | 463.6534 (264)           |
| Space and water heating                                                                           |                    |                               | 623.2524 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 246.3874           | 0.5190                        | 127.8751 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 790.0525 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.6344 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3871 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7266 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.6344 * 1.00) + 2.3871 + 0.7266, rounded to 2 d.p. |                    |                               | 14.7500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000798                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.12_2B |                |            |
| Property                           | A_1_14.12_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.69        | TER            | 13.82      |
| Environmental                      | 89 B                                | % DER<TER     | -6.28        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.96                                | DFEE          | 38.33        | TFEE           | 29.80      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -28.60       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 75 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.82 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.69 kgCO<sub>2</sub>/m<sup>2</sup>Fail  
Excess emissions =0.87 kgCO<sub>2</sub>/m<sup>2</sup> (6.3%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)29.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)38.3 kWh/m<sup>2</sup>/yrFail  
Excess energy =8.5 kWh/m<sup>2</sup>/yr (28.5%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                            |    |
|-------------------------|--------------------------------------------------------------------------------------------|----|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room stats | OK |
|-------------------------|--------------------------------------------------------------------------------------------|----|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |     |    |
|----------------------------------------------------------|-----|----|
| Percentage of fixed lights with low-energy fittings:100% |     |    |
| Minimum                                                  | 75% | OK |

#### 8 Mechanical ventilation

|                                      |      |    |
|--------------------------------------|------|----|
| Continuous supply and extract system |      |    |
| Specific fan power:                  | 0.44 |    |
| Maximum                              | 1.5  | OK |
| MVHR efficiency:                     | 91%  |    |
| Minimum:                             | 70%  | OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South East: | 14.40 m <sup>2</sup> , No overhang |
| Windows facing South West: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |             |                | 28.8000              | 1.3258           | 38.1818      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 50.1023     | 28.8000        | 21.3023              | 0.1600           | 3.4084       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 50.1023              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 41.5902      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 74.6000              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 74.6000              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 7.5153 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 49.1055 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 16.9749     | 16.7787        | 16.5825              | 15.6017          | 15.4055      | 14.4246           | 14.4246       | 14.2284 | 14.8170 | 15.4055 | 15.7978 | 16.1902 (38) |
| Heat transfer coeff                                                 | 66.0804     | 65.8842        | 65.6881              | 64.7072          | 64.5110      | 63.5301           | 63.5301       | 63.3340 | 63.9225 | 64.5110 | 64.9034 | 65.2957 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |         |         |         |         | 64.6581 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.8858      | 0.8832         | 0.8805               | 0.8674           | 0.8648       | 0.8516            | 0.8516        | 0.8490  | 0.8569  | 0.8648  | 0.8700  | 0.8753 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |         |         |         |         | 0.8667 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.3524 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 90.0704 (43)                      |
| Daily hot water use                      | Jan 99.0774 | Feb 95.4746 | Mar 91.8718 | Apr 88.2690 | May 84.6661 | Jun 81.0633 | Jul 81.0633 | Aug 84.6661 | Sep 88.2690 | Oct 91.8718 | Nov 95.4746 | Dec 99.0774 (44)                  |
| Energy conte                             | 146.9289    | 128.5050    | 132.6056    | 115.6088    | 110.9294    | 95.7236     | 88.7020     | 101.7869    | 103.0025    | 120.0395    | 131.0325    | 142.2928 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 22.0393     | 19.2757     | 19.8908     | 17.3413     | 16.6394     | 14.3585     | 13.3053     | 15.2680     | 15.4504     | 18.0059     | 19.6549     | 21.3439 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637                                 | 156.4962 | 175.3163 | 184.5262 | 197.5696 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637                                 | 156.4962 | 175.3163 | 184.5262 | 197.5696 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 2067.9974 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 93.0753  | 82.6699  | 88.3128  | 81.2349  | 81.1055  | 74.6231  | 73.7149  | 78.0656                                  | 77.0433  | 84.1346  | 86.3633  | 91.5338 (65)  |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.5244  | 16.4532  | 13.3806  | 10.1300  | 7.5723   | 6.3928   | 6.9077   | 8.9789   | 12.0514  | 15.3021  | 17.8598  | 19.0392 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 207.7869 | 209.9431 | 204.5096 | 192.9423 | 178.3407 | 164.6172 | 155.4491 | 153.2929 | 158.7264 | 170.2937 | 184.8953 | 198.6188 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 (71) |
| Water heating gains (Table 5)                                                       | 125.1012 | 123.0206 | 118.7000 | 112.8262 | 109.0127 | 103.6431 | 99.0791  | 104.9268 | 107.0046 | 113.0841 | 119.9490 | 123.0293 (72) |
| Total internal gains                                                                | 409.6990 | 407.7034 | 394.8767 | 374.1850 | 353.2122 | 332.9397 | 319.7225 | 325.4852 | 336.0690 | 356.9664 | 380.9906 | 398.9738 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          |          | Gains<br>W   |
|-------------|----------|----------|----------|----------|------------|--------------------------------|------------------------------|------------------------------|------------------------------|----------|----------|----------|--------------|
| Southeast   |          |          |          |          | 14.4000    | 36.7938                        | 0.3000                       | 0.8000                       | 0.7700                       |          |          |          | 88.1215 (77) |
| Southwest   |          |          |          |          | 14.4000    | 36.7938                        | 0.3000                       | 0.8000                       | 0.7700                       |          |          |          | 88.1215 (79) |
| -----       |          |          |          |          |            |                                |                              |                              |                              |          |          |          |              |
| Solar gains | 176.2430 | 300.2071 | 410.7565 | 508.9472 | 570.0632   | 565.9409                       | 545.6274                     | 500.0320                     | 444.7624                     | 331.7928 | 211.0986 | 150.8273 | (83)         |
| Total gains | 585.9420 | 707.9105 | 805.6332 | 883.1322 | 923.2755   | 898.8806                       | 865.3498                     | 825.5173                     | 780.8314                     | 688.7592 | 592.0891 | 549.8012 | (84)         |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 31.3591 | 31.4525 | 31.5464 | 32.0246 | 32.1220 | 32.6179 | 32.6179 | 32.7190 | 32.4177 | 32.1220 | 31.9278 | 31.7360      |
| alpha                                                                       | 3.0906  | 3.0968  | 3.1031  | 3.1350  | 3.1415  | 3.1745  | 3.1745  | 3.1813  | 3.1612  | 3.1415  | 3.1285  | 3.1157       |
| util living area                                                            | 0.9283  | 0.8825  | 0.8155  | 0.7107  | 0.5792  | 0.4316  | 0.3169  | 0.3445  | 0.5203  | 0.7485  | 0.8883  | 0.9384 (86)  |
| MIT                                                                         | 19.5248 | 19.8495 | 20.2194 | 20.5878 | 20.8268 | 20.9503 | 20.9859 | 20.9814 | 20.9073 | 20.5871 | 20.0023 | 19.4622 (87) |
| Th 2                                                                        | 20.1796 | 20.1818 | 20.1841 | 20.1953 | 20.1976 | 20.2088 | 20.2088 | 20.2111 | 20.2043 | 20.1976 | 20.1931 | 20.1886 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9197  | 0.8694  | 0.7960  | 0.6823  | 0.5407  | 0.3835  | 0.2621  | 0.2882  | 0.4702  | 0.7167  | 0.8737  | 0.9309 (89)  |
| MIT 2                                                                       | 18.2086 | 18.6692 | 19.1874 | 19.6965 | 20.0070 | 20.1633 | 20.1991 | 20.1976 | 20.1142 | 19.7091 | 18.9015 | 18.1254 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.6832 | 19.0948 | 19.5596 | 20.0179 | 20.3026 | 20.4471 | 20.4828 | 20.4803 | 20.4002 | 20.0257 | 19.2984 | 18.6075 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 18.6832 | 19.0948 | 19.5596 | 20.0179 | 20.3026 | 20.4471 | 20.4828 | 20.4803 | 20.4002 | 20.0257 | 19.2984 | 18.6075 (93) |

#### 8. Space heating requirement

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9002   | 0.8492   | 0.7795   | 0.6757   | 0.5459   | 0.3982   | 0.2812   | 0.3077   | 0.4829   | 0.7094       | 0.8546   | 0.9124 (94)    |
| Useful gains         | 527.4639 | 601.1580 | 627.9797 | 596.7345 | 504.0408 | 357.9425 | 243.3749 | 253.9722 | 377.0442 | 488.5909     | 505.9892 | 501.6636 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 950.4496 | 935.2151 | 857.8569 | 719.4056 | 554.9644 | 371.4639 | 246.6738 | 258.4186 | 402.7251 | 608.0592     | 791.7182 | 940.7448 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 314.7014 | 224.4863 | 171.0287 | 88.3232  | 37.8872  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 88.8844      | 205.7249 | 326.6764 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1457.7125 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 19.5404 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1457.7125 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1530.5981 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2067.9974 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2171.3973 (310a) |
| Electricity used for heat distribution                                                  | 37.0200 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 125.1415 (330a)  |
| Total electricity for the above, kWh/year                                               | 125.1415 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 327.1458 (332)   |
| Total delivered energy for all uses                                                     | 4154.2828 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3896.8373          | 0.2160                        | 841.7169 (367)           |
| Electrical energy for heat distribution                                                    | 37.0200            | 0.5190                        | 19.2134 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 860.9302 (373)           |
| Space and water heating                                                                    |                    |                               | 860.9302 (376)           |
| Pumps and fans                                                                             | 125.1415           | 0.5190                        | 64.9484 (378)            |
| Energy for lighting                                                                        | 327.1458           | 0.5190                        | 169.7887 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1095.6673 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.6900 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 14.6900 ZC1 |
| Total Floor Area                                                                | TFA 74.6000 |
| Assumed number of occupants                                                     | N 2.3524    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.5054 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.3520 ZC3  |
| Total CO2 emissions                                                             | 33.5474 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 33.5474 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 3 * 10 = 30.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | Air changes per hour                    |
| Pressure test                                                             |                 |                      |       |       | 30.0000 / (5) = 0.1609 (8)              |
| Measured/design AP50                                                      |                 |                      |       |       | Yes                                     |
| Infiltration rate                                                         |                 |                      |       |       | 5.0000                                  |
| Number of sides sheltered                                                 |                 |                      |       |       | 0.4109 (18)                             |
| Shelter factor                                                            |                 |                      |       |       | 2 (19)                                  |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
|                                                                           |                 |                      |       |       | (21) = (18) x (20) = 0.3492 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4453 | 0.4365 | 0.4278 | 0.3842 | 0.3754 | 0.3318 | 0.3318 | 0.3230 | 0.3492 | 0.3754 | 0.3929 | 0.4103 (22b) |
| Effective ac    | 0.5991 | 0.5953 | 0.5915 | 0.5738 | 0.5705 | 0.5550 | 0.5550 | 0.5522 | 0.5610 | 0.5705 | 0.5772 | 0.5842 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 18.6500                   | 1.3258                        | 24.7254      |                                | (27)          |
| External Wall 1                                                     | 50.1023                 | 18.6500                    | 31.4523                   | 0.1800                        | 5.6614       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 50.1023                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 30.3868      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 2.5051 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 32.8919 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Heat transfer coeff                                                 | 69.7655                 | 69.5285                    | 69.2963                   | 68.2056                       | 68.0015      | 67.0515                        | 67.0515       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 66.8756                        | 67.4175       |
|                                                                     |                         |                            |                           |                               |              | 68.0015                        | 68.4144       |
|                                                                     |                         |                            |                           |                               |              | 68.8460                        | 68.2046 (39)  |
| HLP                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.8965                         | 0.9037        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 30            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 41            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |          | 2.3524 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |          | 90.0704 (43)   |
| Daily hot water use                                         | 99.0774  | 95.4746  | 91.8718  | 88.2690  | 84.6661  | 81.0633 | 81.0633 | 84.6661  | 88.2690  | 91.8718            | 95.4746  | 99.0774 (44)   |
| Energy conte                                                | 146.9289 | 128.5050 | 132.6056 | 115.6088 | 110.9294 | 95.7236 | 88.7020 | 101.7869 | 103.0025 | 120.0395           | 131.0325 | 142.2928 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |          |          |                    |          |                |
|                                                             | 22.0393  | 19.2757  | 19.8908  | 17.3413  | 16.6394  | 14.3585 | 13.3053 | 15.2680  | 15.4504  | 18.0059            | 19.6549  | 21.3439 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |          | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |          |                |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325  | 22.5798  | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |          |          |                    |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
|                                                                 | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1965.7751 (64) |
|                                                                 | 86.1298  | 76.3965  | 81.3673  | 74.5134  | 74.1599  | 67.9016  | 66.7693  | 71.1201                       | 70.3218     | 77.1891  | 79.6418  | 84.5883 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 18.5244  | 16.4532  | 13.3806  | 10.1300  | 7.5723   | 6.3928   | 6.9077   | 8.9789   | 12.0514  | 15.3021  | 17.8598  | 19.0392 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 207.7869 | 209.9431 | 204.5096 | 192.9423 | 178.3407 | 164.6172 | 155.4491 | 153.2929 | 158.7264 | 170.2937 | 184.8953 | 198.6188 (68) |
| Pumps, fans                                                                         | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 (71) |
| Total internal gains                                                                | 115.7659 | 113.6852 | 109.3646 | 103.4908 | 99.6773  | 94.3078  | 89.7437  | 95.5915  | 97.6692  | 103.7487 | 110.6136 | 113.6939 (72) |
|                                                                                     | 403.3636 | 401.3680 | 388.5414 | 367.8496 | 346.8769 | 326.6044 | 313.3871 | 319.1498 | 329.7336 | 350.6311 | 374.6552 | 392.6385 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area     | Solar flux | g           |          | FF          |          | Access   |          | Gains         |
|-------------|----------|----------|----------|----------|------------|-------------|----------|-------------|----------|----------|----------|---------------|
|             |          |          |          | m2       | Table 6a   | or Table 6b |          | or Table 6c |          | factor   |          | W             |
|             |          |          |          |          | W/m2       |             |          |             |          | Table 6d |          |               |
| Southeast   |          |          |          | 9.3300   | 36.7938    | 0.6300      |          | 0.7000      |          | 0.7700   |          | 104.9128      |
| Southwest   |          |          |          | 9.3200   | 36.7938    | 0.6300      |          | 0.7000      |          | 0.7700   |          | 104.8004 (77) |
|             |          |          |          |          |            |             |          |             |          |          |          |               |
| Solar gains | 209.7132 | 357.2191 | 488.7627 | 605.6007 | 678.3233   | 673.4180    | 649.2468 | 594.9926    | 529.2267 | 394.8032 | 251.1880 | 179.4708 (83) |
| Total gains | 613.0768 | 758.5871 | 877.3041 | 973.4504 | 1025.2002  | 1000.0224   | 962.6339 | 914.1424    | 858.9603 | 745.4343 | 625.8432 | 572.1092 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
| tau                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| alpha                                                                       | 74.2567 | 74.5098 | 74.7595 | 75.9550 | 76.1829 | 77.2623 | 77.2623 | 77.4655 | 76.8429                   | 76.1829 | 75.7232 | 75.2485      |
| util living area                                                            | 5.9504  | 5.9673  | 5.9840  | 6.0637  | 6.0789  | 6.1508  | 6.1508  | 6.1644  | 6.1229                    | 6.0789  | 6.0482  | 6.0166       |
|                                                                             | 0.9895  | 0.9661  | 0.9080  | 0.7789  | 0.6039  | 0.4278  | 0.3063  | 0.3362  | 0.5357                    | 0.8352  | 0.9713  | 0.9926 (86)  |
| MIT                                                                         | 20.2683 | 20.4933 | 20.7269 | 20.9118 | 20.9825 | 20.9982 | 20.9998 | 20.9997 | 20.9933                   | 20.8886 | 20.5489 | 20.2269 (87) |
| Th 2                                                                        | 20.1377 | 20.1404 | 20.1430 | 20.1554 | 20.1577 | 20.1685 | 20.1685 | 20.1705 | 20.1643                   | 20.1577 | 20.1530 | 20.1481 (88) |
| util rest of house                                                          | 0.9864  | 0.9572  | 0.8868  | 0.7400  | 0.5535  | 0.3728  | 0.2485  | 0.2758  | 0.4733                    | 0.7937  | 0.9621  | 0.9904 (89)  |
| MIT 2                                                                       | 19.1779 | 19.4999 | 19.8213 | 20.0643 | 20.1430 | 20.1675 | 20.1684 | 20.1704 | 20.1599                   | 20.0454 | 19.5928 | 19.1261 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3606 (91)  |
| MIT                                                                         | 19.5711 | 19.8581 | 20.1479 | 20.3699 | 20.4457 | 20.4670 | 20.4682 | 20.4694 | 20.4604                   | 20.3494 | 19.9376 | 19.5230 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.5711 | 19.8581 | 20.1479 | 20.3699 | 20.4457 | 20.4670 | 20.4682 | 20.4694 | 20.4604                   | 20.3494 | 19.9376 | 19.5230 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9838    | 0.9537    | 0.8869   | 0.7503   | 0.5710   | 0.3926   | 0.2694   | 0.2976   | 0.4956   | 0.8038       | 0.9592   | 0.9883 (94)    |
| Ext temp.            | 603.1503  | 723.4559  | 778.0910 | 730.4224 | 585.4065 | 392.6233 | 259.3110 | 272.0359 | 425.7315 | 599.2014     | 600.3337 | 565.4235 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1065.3929 | 1040.0159 | 945.7462 | 782.3109 | 594.7202 | 393.3925 | 259.3705 | 272.1449 | 428.8052 | 662.9766     | 878.2753 | 1054.9284 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 343.9085  | 212.7283  | 124.7355 | 37.3597  | 6.9295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 47.4488      | 200.1179 | 364.1917 (98)  |
|                      |           |           |          |          |          |          |          |          |          |              |          | 1337.4199 (98) |
|                      |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 17.9279 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1430.3956 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 343.9085 | 212.7283 | 124.7355 | 37.3597  | 6.9295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 47.4488  | 200.1179 | 364.1917  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 367.8166 | 227.5169 | 133.4069 | 39.9569  | 7.4112   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.7474  | 214.0299 | 389.5098  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818 | 148.0944 | 166.6344 | 176.1244 | 188.8877  | (64)            |
| Efficiency of water heater                                            | 86.3317  | 85.4037  | 83.8696  | 81.6203  | 80.1995  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.9474  | 85.1551  | 86.5372   | (217)           |
| Fuel for water heating, kWh/month                                     | 224.1632 | 199.7462 | 213.6658 | 196.8881 | 196.4155 | 176.4605 | 169.5450 | 185.9421 | 185.5819 | 203.3431 | 206.8278 | 218.2734  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2376.8526 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1430.3956 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 327.1458  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4209.3940 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1430.3956          | 0.2160                        | 308.9654 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2376.8526          | 0.2160                        | 513.4002 (264)           |
| Space and water heating                                                                           |                    |                               | 822.3656 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 327.1458           | 0.5190                        | 169.7887 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1031.0793 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.0237 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2760 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5218 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.0237 * 1.00) + 2.2760 + 0.5218, rounded to 2 d.p. |                    |                               | 13.8200 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000842                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.12_2B |                |            |
| Property                           | A_1_14.12_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 12.25        | TER            | 13.82      |
| Environmental                      | 90 B                                | % DER<TER     | 11.37        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.83                                | DFEE          | 28.54        | TFEE           | 29.80      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 4.23         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 75 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.82 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.25 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)29.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)28.5 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South East: | 14.40 m <sup>2</sup> , No overhang |
| Windows facing South West: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K              |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|----------------------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |             |                | 28.8000              | 0.9615           | 27.6923      |                   | (27)                       |         |         |         |         |              |
| External Wall 1                                                     | 50.1023     | 28.8000        | 21.3023              | 0.1600           | 3.4084       |                   | (29a)                      |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 50.1023              |                  |              |                   | (31)                       |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 31.1007      |                   | (33)                       |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 74.6000              |                  |              |                   | (32d)                      |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 74.6000              |                  |              |                   | (32b)                      |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   | 100.0000 (35)              |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 7.5153 (36)                |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   | (33) + (36) = 38.6160 (37) |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 16.9749     | 16.7787        | 16.5825              | 15.6017          | 15.4055      | 14.4246           | 14.4246                    | 14.2284 | 14.8170 | 15.4055 | 15.7978 | 16.1902 (38) |
| Heat transfer coeff                                                 | 55.5909     | 55.3947        | 55.1986              | 54.2177          | 54.0215      | 53.0406           | 53.0406                    | 52.8445 | 53.4330 | 54.0215 | 54.4139 | 54.8062 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |                            |         |         |         |         | 54.1686 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.7452      | 0.7426         | 0.7399               | 0.7268           | 0.7241       | 0.7110            | 0.7110                     | 0.7084  | 0.7163  | 0.7241  | 0.7294  | 0.7347 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |                            |         |         |         |         | 0.7261 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31                         | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.3524 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 90.0704 (43)                      |
| Daily hot water use                      | Jan 99.0774 | Feb 95.4746 | Mar 91.8718 | Apr 88.2690 | May 84.6661 | Jun 81.0633 | Jul 81.0633 | Aug 84.6661 | Sep 88.2690 | Oct 91.8718 | Nov 95.4746 | Dec 99.0774 (44)                  |
| Energy conte                             | 146.9289    | 128.5050    | 132.6056    | 115.6088    | 110.9294    | 95.7236     | 88.7020     | 101.7869    | 103.0025    | 120.0395    | 131.0325    | 142.2928 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 22.0393     | 19.2757     | 19.8908     | 17.3413     | 16.6394     | 14.3585     | 13.3053     | 15.2680     | 15.4504     | 18.0059     | 19.6549     | 21.3439 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|-----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)                             |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)                             |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)                             |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)                             |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)                            |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)                            |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)                            |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637                                  | 156.4962 | 175.3163 | 184.5262 | 197.5696 (62)                           |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)                             |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |                                         | 0.0000 (63)    |
| Output from w/h                                                 | 202.2057 | 178.4324 | 187.8824 | 169.1025 | 166.2062 | 149.2173 | 143.9788 | 157.0637                                  | 156.4962 | 175.3163 | 184.5262 | 197.5696 (64)                           |                |
|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          | Total per year (kWh/year) = Sum (64)m = | 2067.9974 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 93.0753  | 82.6699  | 88.3128  | 81.2349  | 81.1055  | 74.6231  | 73.7149  | 78.0656                                   | 77.0433  | 84.1346  | 86.3633  | 91.5338 (65)                            |                |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8421   | 0.7423   | 0.6263   | 0.4879   | 0.3596   | 0.2468   | 0.1711   | 0.1899   | 0.3165   | 0.5445       | 0.7620   | 0.8638 (94)   |
| Useful gains         | 592.3337 | 674.0205 | 676.0798 | 596.4324 | 468.6456 | 314.9119 | 210.3338 | 220.0336 | 340.9393 | 495.4534     | 558.4318 | 561.7865 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 844.4289 | 831.9097 | 758.3599 | 626.3383 | 477.2163 | 316.4767 | 210.6362 | 220.4775 | 344.9107 | 531.0784     | 700.9509 | 833.1183 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 187.5588 | 106.1016 | 61.2164  | 21.5322  | 6.3766   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 26.5050      | 102.6137 | 201.8709 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 713.7752 (99) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 9.5680 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 713.7752 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 749.4640 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2067.9974 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2171.3973 (310a) |
| Electricity used for heat distribution                                                  | 29.2086 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 125.1415 (330a)  |
| Total electricity for the above, kWh/year                                               | 125.1415 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 327.1458 (332)   |
| Total delivered energy for all uses                                                     | 3373.1486 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3074.5908          | 0.2160                        | 664.1116 (367)           |
| Electrical energy for heat distribution                                                    | 29.2086            | 0.5190                        | 15.1593 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 679.2709 (373)           |
| Space and water heating                                                                    |                    |                               | 679.2709 (376)           |
| Pumps and fans                                                                             | 125.1415           | 0.5190                        | 64.9484 (378)            |
| Energy for lighting                                                                        | 327.1458           | 0.5190                        | 169.7887 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 914.0080 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.2500 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 12.2500 ZC1 |
| Total Floor Area                                                                | TFA 74.6000 |
| Assumed number of occupants                                                     | N 2.3524    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.5054 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.3520 ZC3  |
| Total CO2 emissions                                                             | 31.1074 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 31.1074 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.6000 (1b)              | x 2.5000 (2b)                   | = 186.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.6000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 186.5000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 30.0000 / (5) = 0.1609 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4109 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3492 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4453 | 0.4365 | 0.4278 | 0.3842 | 0.3754 | 0.3318 | 0.3318 | 0.3230 | 0.3492 | 0.3754 | 0.3929 | 0.4103 (22b) |
|                 | 0.5991 | 0.5953 | 0.5915 | 0.5738 | 0.5705 | 0.5550 | 0.5550 | 0.5522 | 0.5610 | 0.5705 | 0.5772 | 0.5842 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 18.6500                   | 1.3258                        | 24.7254      |                                | (27)          |
| External Wall 1                                                     | 50.1023                 | 18.6500                    | 31.4523                   | 0.1800                        | 5.6614       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 50.1023                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 30.3868      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 2.5051 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 32.8919 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| Jan                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Feb                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Mar                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Apr                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| May                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Jun                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Jul                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Aug                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Sep                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Oct                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Nov                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Dec                                                                 | 36.8735                 | 36.6366                    | 36.4044                   | 35.3137                       | 35.1096      | 34.1596                        | 34.1596       |
| Heat transfer coeff                                                 | 69.7655                 | 69.5285                    | 69.2963                   | 68.2056                       | 68.0015      | 67.0515                        | 67.0515       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| Jan                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Feb                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Mar                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Apr                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| May                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Jun                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Jul                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Aug                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Sep                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Oct                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Nov                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| Dec                                                                 | 0.9352                  | 0.9320                     | 0.9289                    | 0.9143                        | 0.9115       | 0.8988                         | 0.8988        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                | 0.9229 (40)   |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              |                                | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |              |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|--------------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |              | 2.3524 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |              | 90.0704 (43)   |
| Jan                                                         | 99.0774  | 95.4746  | 91.8718  | 88.2690  | 84.6661  | 81.0633 | 81.0633 | 84.6661  | 88.2690  | 91.8718            | 95.4746      | 99.0774 (44)   |
| Energy conte                                                | 146.9289 | 128.5050 | 132.6056 | 115.6088 | 110.9294 | 95.7236 | 88.7020 | 101.7869 | 103.0025 | 120.0395           | 131.0325     | 142.2928 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |              | 1417.1577 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |          |          |                    |              |                |
| 22.0393                                                     | 19.2757  | 19.8908  | 17.3413  | 16.6394  | 14.3585  | 13.3053 | 15.2680 | 15.4504  | 18.0059  | 19.6549            | 21.3439 (46) |                |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |              |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |              | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |              | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |              | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |              | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |              |                |
| 23.3325                                                     | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325 | 22.5798  | 23.3325  | 22.5798            | 23.3325 (56) |                |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |          |          |                    |              |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818                      | 148.0944    | 166.6344 | 176.1244 | 188.8877 (64)  |
|                                                                 | 86.1298  | 76.3965  | 81.3673  | 74.5134  | 74.1599  | 67.9016  | 66.7693  | 71.1201                       | 70.3218     | 77.1891  | 79.6418  | 84.5883 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1965.7751 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 | 117.6218 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 18.5244  | 16.4532  | 13.3806  | 10.1300  | 7.5723   | 6.3928   | 6.9077   | 8.9789   | 12.0514  | 15.3021  | 17.8598  | 19.0392 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 207.7869 | 209.9431 | 204.5096 | 192.9423 | 178.3407 | 164.6172 | 155.4491 | 153.2929 | 158.7264 | 170.2937 | 184.8953 | 198.6188 (68) |
| Pumps, fans                                                                         | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622  | 34.7622 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 | -94.0975 (71) |
| Total internal gains                                                                | 115.7659 | 113.6852 | 109.3646 | 103.4908 | 99.6773  | 94.3078  | 89.7437  | 95.5915  | 97.6692  | 103.7487 | 110.6136 | 113.6939 (72) |
|                                                                                     | 403.3636 | 401.3680 | 388.5414 | 367.8496 | 346.8769 | 326.6044 | 313.3871 | 319.1498 | 329.7336 | 350.6311 | 374.6552 | 392.6385 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area     | Solar flux | g           |          | FF          |          | Access   |          | Gains         |
|-------------|----------|----------|----------|----------|------------|-------------|----------|-------------|----------|----------|----------|---------------|
|             |          |          |          | m2       | Table 6a   | or Table 6b |          | or Table 6c |          | factor   |          | W             |
|             |          |          |          |          | W/m2       |             |          |             |          | Table 6d |          |               |
| Southeast   |          |          |          | 9.3300   | 36.7938    | 0.6300      |          | 0.7000      |          | 0.7700   |          | 104.9128      |
| Southwest   |          |          |          | 9.3200   | 36.7938    | 0.6300      |          | 0.7000      |          | 0.7700   |          | 104.8004 (77) |
|             |          |          |          |          |            |             |          |             |          |          |          |               |
| Solar gains | 209.7132 | 357.2191 | 488.7627 | 605.6007 | 678.3233   | 673.4180    | 649.2468 | 594.9926    | 529.2267 | 394.8032 | 251.1880 | 179.4708 (83) |
| Total gains | 613.0768 | 758.5871 | 877.3041 | 973.4504 | 1025.2002  | 1000.0224   | 962.6339 | 914.1424    | 858.9603 | 745.4343 | 625.8432 | 572.1092 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
| tau                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| alpha                                                                       | 74.2567 | 74.5098 | 74.7595 | 75.9550 | 76.1829 | 77.2623 | 77.2623 | 77.4655 | 76.8429                   | 76.1829 | 75.7232 | 75.2485      |
| util living area                                                            | 5.9504  | 5.9673  | 5.9840  | 6.0637  | 6.0789  | 6.1508  | 6.1508  | 6.1644  | 6.1229                    | 6.0789  | 6.0482  | 6.0166       |
|                                                                             | 0.9895  | 0.9661  | 0.9080  | 0.7789  | 0.6039  | 0.4278  | 0.3063  | 0.3362  | 0.5357                    | 0.8352  | 0.9713  | 0.9926 (86)  |
| MIT                                                                         | 20.2683 | 20.4933 | 20.7269 | 20.9118 | 20.9825 | 20.9982 | 20.9998 | 20.9997 | 20.9933                   | 20.8886 | 20.5489 | 20.2269 (87) |
| Th 2                                                                        | 20.1377 | 20.1404 | 20.1430 | 20.1554 | 20.1577 | 20.1685 | 20.1685 | 20.1705 | 20.1643                   | 20.1577 | 20.1530 | 20.1481 (88) |
| util rest of house                                                          | 0.9864  | 0.9572  | 0.8868  | 0.7400  | 0.5535  | 0.3728  | 0.2485  | 0.2758  | 0.4733                    | 0.7937  | 0.9621  | 0.9904 (89)  |
| MIT 2                                                                       | 19.1779 | 19.4999 | 19.8213 | 20.0643 | 20.1430 | 20.1675 | 20.1684 | 20.1704 | 20.1599                   | 20.0454 | 19.5928 | 19.1261 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3606 (91)  |
| MIT                                                                         | 19.5711 | 19.8581 | 20.1479 | 20.3699 | 20.4457 | 20.4670 | 20.4682 | 20.4694 | 20.4604                   | 20.3494 | 19.9376 | 19.5230 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.5711 | 19.8581 | 20.1479 | 20.3699 | 20.4457 | 20.4670 | 20.4682 | 20.4694 | 20.4604                   | 20.3494 | 19.9376 | 19.5230 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9838    | 0.9537    | 0.8869   | 0.7503   | 0.5710   | 0.3926   | 0.2694   | 0.2976   | 0.4956   | 0.8038       | 0.9592   | 0.9883 (94)    |
| Ext temp.            | 603.1503  | 723.4559  | 778.0910 | 730.4224 | 585.4065 | 392.6233 | 259.3110 | 272.0359 | 425.7315 | 599.2014     | 600.3337 | 565.4235 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1065.3929 | 1040.0159 | 945.7462 | 782.3109 | 594.7202 | 393.3925 | 259.3705 | 272.1449 | 428.8052 | 662.9766     | 878.2753 | 1054.9284 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 343.9085  | 212.7283  | 124.7355 | 37.3597  | 6.9295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 47.4488      | 200.1179 | 364.1917 (98)  |
|                      |           |           |          |          |          |          |          |          |          |              |          | 1337.4199 (98) |
|                      |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 17.9279 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1430.3956 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 343.9085 | 212.7283 | 124.7355 | 37.3597  | 6.9295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 47.4488  | 200.1179 | 364.1917  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 367.8166 | 227.5169 | 133.4069 | 39.9569  | 7.4112   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 50.7474  | 214.0299 | 389.5098  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Water heating requirement                                             | 193.5238 | 170.5907 | 179.2005 | 160.7006 | 157.5243 | 140.8155 | 135.2969 | 148.3818 | 148.0944 | 166.6344 | 176.1244 | 188.8877  | (64)            |
| Efficiency of water heater                                            | 86.3317  | 85.4037  | 83.8696  | 81.6203  | 80.1995  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.9474  | 85.1551  | 86.5372   | (217)           |
| Fuel for water heating, kWh/month                                     | 224.1632 | 199.7462 | 213.6658 | 196.8881 | 196.4155 | 176.4605 | 169.5450 | 185.9421 | 185.5819 | 203.3431 | 206.8278 | 218.2734  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2376.8526 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1430.3956 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 327.1458  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4209.3940 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1430.3956          | 0.2160                        | 308.9654 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2376.8526          | 0.2160                        | 513.4002 (264)           |
| Space and water heating                                                                           |                    |                               | 822.3656 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 327.1458           | 0.5190                        | 169.7887 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1031.0793 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.0237 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2760 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5218 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.0237 * 1.00) + 2.2760 + 0.5218, rounded to 2 d.p. |                    |                               | 13.8200 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000870                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.13_1B |                |            |
| Property                           | A_1_14.13_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 82 B                                | DER           | 17.77        | TER            | 16.40      |
| Environmental                      | 88 B                                | % DER<TER     | -8.35        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.84                                | DFEE          | 45.04        | TFEE           | 33.83      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -33.14       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 53 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.40 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 17.77 kgCO<sub>2</sub>/m<sup>2</sup>Fail  
Excess emissions =1.37 kgCO<sub>2</sub>/m<sup>2</sup> (8.4%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)33.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)45.0 kWh/m<sup>2</sup>/yrFail  
Excess energy =11.2 kWh/m<sup>2</sup>/yr (33.1%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 13.20 m <sup>2</sup> , No overhang |
| Windows facing North West: | 12.00 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4400 (1b)              | x 2.5000 (2b)                   | = 133.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6000 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    |        | secondary |        |        | other  |        | total    | m3 per hour                 |  |               |  |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|--------|-----------|--------|--------|--------|--------|----------|-----------------------------|--|---------------|--|
|                                                                                              |        |        |        |        | heating | +      | heating   |        |        |        | =      | 0 * 40 = | 0.0000 (6a)                 |  |               |  |
|                                                                                              |        |        |        |        | 0       | +      | 0         | +      |        | 0      | =      | 0 * 20 = | 0.0000 (6b)                 |  |               |  |
|                                                                                              |        |        |        |        | 0       | +      | 0         | +      |        | 0      | =      | 0 * 10 = | 0.0000 (7a)                 |  |               |  |
| Number of intermittent fans                                                                  |        |        |        |        |         |        |           |        |        |        |        | 0 * 10 = | 0.0000 (7b)                 |  |               |  |
| Number of passive vents                                                                      |        |        |        |        |         |        |           |        |        |        |        | 0 * 10 = | 0.0000 (7c)                 |  |               |  |
| Number of flueless gas fires                                                                 |        |        |        |        |         |        |           |        |        |        |        | 0 * 40 = | 0.0000 (7c)                 |  |               |  |
|                                                                                              |        |        |        |        |         |        |           |        |        |        |        |          | Air changes per hour        |  |               |  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                    |        |        |        |        |         |        |           |        |        |        |        |          | 0.0000 / (5) =              |  | 0.0000 (8)    |  |
| Pressure test                                                                                |        |        |        |        |         |        |           |        |        |        |        |          | Yes                         |  |               |  |
| Measured/design AP50                                                                         |        |        |        |        |         |        |           |        |        |        |        |          | 3.0000                      |  |               |  |
| Infiltration rate                                                                            |        |        |        |        |         |        |           |        |        |        |        |          | 0.1500                      |  | (18)          |  |
| Number of sides sheltered                                                                    |        |        |        |        |         |        |           |        |        |        |        |          | 2                           |  | (19)          |  |
| Shelter factor                                                                               |        |        |        |        |         |        |           |        |        |        |        |          | (20) = 1 - [0.075 x (19)] = |  | 0.8500 (20)   |  |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |        |           |        |        |        |        |          | (21) = (18) x (20) =        |  | 0.1275 (21)   |  |
|                                                                                              |        |        |        |        |         |        |           |        |        |        |        |          |                             |  |               |  |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun    | Jul       | Aug    | Sep    | Oct    | Nov    | Dec      |                             |  |               |  |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000 | 3.8000    | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000   | (22)                        |  |               |  |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500 | 0.9500    | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750   | (22a)                       |  |               |  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371  | 0.1211 | 0.1211    | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498   | (22b)                       |  |               |  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |        |           |        |        |        |        |          |                             |  |               |  |
| If mechanical ventilation:                                                                   |        |        |        |        |         |        |           |        |        |        |        |          |                             |  | 0.5000 (23a)  |  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |        |           |        |        |        |        |          |                             |  | 77.3500 (23c) |  |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503  | 0.2344 | 0.2344    | 0.2312 | 0.2408 | 0.2503 | 0.2567 | 0.2631   | (25)                        |  |               |  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|---------------|----------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 25.2000       | 1.3258               | 33.4091      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 40.0425       | 25.2000        | 14.8425       | 0.1600               | 2.3748       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 40.0425       |                      |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                |               | (26)...(30) + (32) = | 35.7839      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 53.4400       |                      |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 53.4400       |                      |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |               |                      |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |               |                      |              |                   | 6.0064 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |               |                      |              |                   | 41.7903 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |               |                      |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 12.1600       | 12.0195        | 11.8790       | 11.1763              | 11.0358      | 10.3331           | 10.3331       | 10.1926 | 10.6142 | 11.0358 | 11.3168 | 11.5979 (38) |
| Heat transfer coeff                                                 | 53.9503       | 53.8098        | 53.6692       | 52.9666              | 52.8260      | 52.1234           | 52.1234       | 51.9829 | 52.4045 | 52.8260 | 53.1071 | 53.3882 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |               |                      |              |                   |               |         |         |         |         | 52.9314 (39) |
|                                                                     | Jan           | Feb            | Mar           | Apr                  | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 1.0095        | 1.0069         | 1.0043        | 0.9911               | 0.9885       | 0.9754            | 0.9754        | 0.9727  | 0.9806  | 0.9885  | 0.9938  | 0.9990 (40)  |
| HLP (average)                                                       |               |                |               |                      |              |                   |               |         |         |         |         | 0.9905 (40)  |
| Days in month                                                       | 31            | 28             | 31            | 30                   | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.7915 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 76.7487 (43)                      |
| Daily hot water use                      | Jan 84.4236 | Feb 81.3536 | Mar 78.2837 | Apr 75.2137 | May 72.1438 | Jun 69.0738 | Jul 69.0738 | Aug 72.1438 | Sep 75.2137 | Oct 78.2837 | Nov 81.3536 | Dec 84.4236 (44)                  |
| Energy conte                             | 125.1977    | 109.4987    | 112.9929    | 98.5099     | 94.5226     | 81.5658     | 75.5827     | 86.7323     | 87.7681     | 102.2853    | 111.6524    | 121.2473 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1207.5558 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 18.7797     | 16.4248     | 16.9489     | 14.7765     | 14.1784     | 12.2349     | 11.3374     | 13.0098     | 13.1652     | 15.3428     | 16.7479     | 18.1871 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|-----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)                             |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)                             |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)                             |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)                             |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144                                 | (56)           |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144                                 | (57)           |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624                                 | (59)           |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 180.4745 | 159.4261 | 168.2697 | 152.0036 | 149.7994 | 135.0595 | 130.8595 | 142.0091                                  | 141.2618 | 157.5621 | 165.1461 | 176.5241                                | (62)           |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000                                  | (63)           |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |                                         | 0.0000 (63)    |
| Output from w/h                                                 | 180.4745 | 159.4261 | 168.2697 | 152.0036 | 149.7994 | 135.0595 | 130.8595 | 142.0091                                  | 141.2618 | 157.5621 | 165.1461 | 176.5241                                | (64)           |
|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          | Total per year (kWh/year) = Sum (64)m = | 1858.3955 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 85.8497  | 76.3503  | 81.7916  | 75.5495  | 75.6502  | 69.9156  | 69.3527  | 73.0599                                   | 71.9779  | 78.2313  | 79.9194  | 84.5362                                 | (65)           |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.8995   | 0.8577   | 0.7919   | 0.6840   | 0.5463   | 0.3977   | 0.2852   | 0.3207   | 0.5109   | 0.7325       | 0.8598   | 0.9100 (94)    |
| Useful gains         | 394.5555 | 443.4791 | 470.7067 | 462.5997 | 401.4631 | 289.9874 | 198.7912 | 206.6056 | 297.6861 | 368.1555     | 376.8955 | 377.2761 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 763.2635 | 749.4867 | 689.3174 | 582.6881 | 452.3743 | 304.5936 | 202.8410 | 212.3560 | 328.3103 | 490.2229     | 636.5129 | 756.9510 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 274.3187 | 205.6371 | 162.6463 | 86.4637  | 37.8779  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.8181      | 186.9246 | 282.4781 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1327.1646 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 24.8347 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1327.1646 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1393.5228 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1858.3955 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1951.3153 (310a) |
| Electricity used for heat distribution                                                  | 33.4484 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.5708 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.5708 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 245.8579 (332)   |
| Total delivered energy for all uses                                                     | 3676.2668 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3520.8822          | 0.2160                        | 760.5106 (367)           |
| Electrical energy for heat distribution                                                    | 33.4484            | 0.5190                        | 17.3597 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 777.8703 (373)           |
| Space and water heating                                                                    |                    |                               | 777.8703 (376)           |
| Pumps and fans                                                                             | 85.5708            | 0.5190                        | 44.4112 (378)            |
| Energy for lighting                                                                        | 245.8579           | 0.5190                        | 127.6002 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 949.8817 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.7700 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 17.7700 ZC1 |
| Total Floor Area                                                                | TFA | 53.4400     |
| Assumed number of occupants                                                     | N   | 1.7915      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.3157 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.0314 ZC3  |
| Total CO2 emissions                                                             |     | 38.1171 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 38.1171 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4400 (1b)              | x 2.5000 (2b)                   | = 133.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | +                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             |                 | Air changes per hour    |
| Pressure test                                                             |                 |                      |                             | 20.0000 / (5) = | 0.1497 (8)              |
| Measured/design AP50                                                      |                 |                      |                             |                 | Yes                     |
| Infiltration rate                                                         |                 |                      |                             |                 | 5.0000                  |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0.3997 (18)             |
|                                                                           |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3397 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4332 | 0.4247 | 0.4162 | 0.3737 | 0.3652 | 0.3228 | 0.3228 | 0.3143 | 0.3397 | 0.3652 | 0.3822 | 0.3992 (22b) |
| Effective ac    | 0.5938 | 0.5902 | 0.5866 | 0.5698 | 0.5667 | 0.5521 | 0.5521 | 0.5494 | 0.5577 | 0.5667 | 0.5730 | 0.5797 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 13.3600                   | 1.3258                        | 17.7121      |                                | (27)          |
| External Wall 1                                                     | 40.0425                 | 13.3600                    | 26.6825                   | 0.1800                        | 4.8029       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 40.0425                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 22.5150      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 2.0021 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 24.5171 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 26.1804                 | 26.0197                    | 25.8623                   | 25.1228                       | 24.9845      | 24.3404                        | 24.3404       |
| Heat transfer coeff                                                 | 50.6975                 | 50.5368                    | 50.3794                   | 49.6399                       | 49.5016      | 48.8575                        | 48.8575       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 48.7382                        | 49.1056       |
|                                                                     |                         |                            |                           |                               |              | 49.5016                        | 49.5016       |
|                                                                     |                         |                            |                           |                               |              | 49.7814                        | 50.0741 (39)  |
|                                                                     |                         |                            |                           |                               |              |                                | 49.6392 (39)  |
| HLP                                                                 | 0.9487                  | 0.9457                     | 0.9427                    | 0.9289                        | 0.9263       | 0.9142                         | 0.9142        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.9120                         | 0.9189        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 30            |
|                                                                     |                         |                            |                           |                               |              |                                | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7915 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 76.7487 (43)   |
| Daily hot water use                                         | 84.4236  | 81.3536  | 78.2837  | 75.2137 | 72.1438 | 69.0738 | 69.0738 | 72.1438 | 75.2137 | 78.2837            | 81.3536  | 84.4236 (44)   |
| Energy conte                                                | 125.1977 | 109.4987 | 112.9929 | 98.5099 | 94.5226 | 81.5658 | 75.5827 | 86.7323 | 87.7681 | 102.2853           | 111.6524 | 121.2473 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1207.5558 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.7797  | 16.4248  | 16.9489  | 14.7765 | 14.1784 | 12.2349 | 11.3374 | 13.0098 | 13.1652 | 15.3428            | 16.7479  | 18.1871 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                                   | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.7926 | 151.5844 | 159.5878 | 143.6018 | 141.1175 | 126.6577 | 122.1776 | 133.3272                                  | 132.8600 | 148.8802 | 156.7443 | 167.8422 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.7926 | 151.5844 | 159.5878 | 143.6018 | 141.1175 | 126.6577 | 122.1776 | 133.3272                                  | 132.8600 | 148.8802 | 156.7443 | 167.8422 (64)  |
|                                                                 | 78.9042  | 70.0769  | 74.8460  | 68.8280  | 68.7047  | 63.1941  | 62.4072  | 66.1144                                   | 65.2564  | 71.2858  | 73.1979  | 77.5906 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          | 1756.1732 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9215  | 12.3649  | 10.0558  | 7.6129   | 5.6907   | 4.8044   | 5.1913   | 6.7478   | 9.0569   | 11.4999  | 13.4220  | 14.3084  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.1568 | 157.7772 | 153.6938 | 145.0007 | 134.0273 | 123.7138 | 116.8237 | 115.2033 | 119.2867 | 127.9798 | 138.9532 | 149.2667 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | (71) |
| Water heating gains (Table 5)                                                       | 106.0540 | 104.2811 | 100.5995 | 95.5945  | 92.3450  | 87.7696  | 83.8806  | 88.8634  | 90.6339  | 95.8142  | 101.6637 | 104.2885 | (72) |
| Total internal gains                                                                | 329.0051 | 327.2961 | 317.2220 | 301.0810 | 284.9359 | 269.1606 | 258.7685 | 263.6874 | 271.8503 | 288.1667 | 306.9119 | 320.7365 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          |          | Access<br>factor<br>Table 6d |  |               | Gains<br>W   |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|----------|------------------------------|--|---------------|--------------|
| Southwest   |          |          |          |          | 7.0000     | 36.7938                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       |  |               | 78.7127 (79) |
| Northwest   |          |          |          |          | 6.3600     | 11.2829                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       |  |               | 21.9306 (81) |
|             |          |          |          |          |            |                                |                                   |                                    |          |          |          |                              |  |               |              |
| Solar gains | 100.6434 | 178.7173 | 263.8777 | 359.3889 | 432.1477   | 442.0436                       | 420.7584                          | 364.4865                           | 296.6400 | 202.7377 | 121.8741 |                              |  | 85.2713 (83)  |              |
| Total gains | 429.6485 | 506.0134 | 581.0997 | 660.4699 | 717.0835   | 711.2042                       | 679.5269                          | 628.1739                           | 568.4904 | 490.9044 | 428.7860 |                              |  | 406.0078 (84) |              |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 73.2011 | 73.4338 | 73.6633 | 74.7606 | 74.9696 | 75.9579 | 75.9579 | 76.1438 | 75.5741 | 74.9696 | 74.5481 | 74.1124 |              |
| alpha                                                                       | 5.8801  | 5.8956  | 5.9109  | 5.9840  | 5.9980  | 6.0639  | 6.0639  | 6.0763  | 6.0383  | 5.9980  | 5.9699  | 5.9408  |              |
| util living area                                                            | 0.9908  | 0.9761  | 0.9334  | 0.8131  | 0.6251  | 0.4380  | 0.3162  | 0.3565  | 0.5851  | 0.8767  | 0.9773  | 0.9931  | (86)         |
| MIT                                                                         | 20.2320 | 20.4164 | 20.6565 | 20.8836 | 20.9778 | 20.9978 | 20.9997 | 20.9995 | 20.9887 | 20.8453 | 20.5005 | 20.1991 | (87)         |
| Th 2                                                                        | 20.1263 | 20.1289 | 20.1313 | 20.1430 | 20.1452 | 20.1554 | 20.1554 | 20.1573 | 20.1515 | 20.1452 | 20.1408 | 20.1362 | (88)         |
| util rest of house                                                          | 0.9880  | 0.9694  | 0.9163  | 0.7759  | 0.5732  | 0.3810  | 0.2556  | 0.2914  | 0.5177  | 0.8402  | 0.9698  | 0.9910  | (89)         |
| MIT 2                                                                       | 19.1167 | 19.3827 | 19.7186 | 20.0206 | 20.1264 | 20.1541 | 20.1553 | 20.1571 | 20.1438 | 19.9841 | 19.5152 | 19.0767 | (90)         |
| Living area fraction                                                        | 19.6216 | 19.8506 | 20.1432 | 20.4112 | 20.5118 | 20.5360 | 20.5376 | 20.5384 | 20.5262 | 20.3739 | 19.9612 | 19.5848 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.6216 | 19.8506 | 20.1432 | 20.4112 | 20.5118 | 20.5360 | 20.5376 | 20.5384 | 20.5262 | 20.3739 | 19.9612 | 19.5848 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 423.6432 | 489.2309 | 532.6123 | 520.5215 | 427.2572 | 289.2708 | 192.3135 | 201.5614 | 311.4837 | 417.6618 | 415.0099 | 401.6834  | (94)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 776.7653 | 755.5568 | 687.3341 | 571.4150 | 436.1980 | 290.0179 | 192.3790 | 201.6990 | 315.5642 | 483.8240 | 640.2508 | 770.3798  | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 262.7229 | 178.9710 | 115.1130 | 36.6433  | 6.6519   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 49.2247  | 162.1735 | 274.3102  | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1085.8103 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 20.3183   | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1161.2944 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 262.7229 | 178.9710 | 115.1130 | 36.6433  | 6.6519   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 49.2247  | 162.1735 | 274.3102  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 280.9870 | 191.4128 | 123.1155 | 39.1907  | 7.1143   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 52.6467  | 173.4476 | 293.3798  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 171.7926 | 151.5844 | 159.5878 | 143.6018 | 141.1175 | 126.6577 | 122.1776 | 133.3272 | 132.8600 | 148.8802 | 156.7443 | 167.8422  | (64)            |
| Efficiency of water heater (217)m                                     | 85.9439  | 85.2577  | 83.9598  | 81.7653  | 80.2270  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2153  | 84.9047  | 86.1167   | (217)           |
| Fuel for water heating, kWh/month                                     | 199.8893 | 177.7957 | 190.0764 | 175.6267 | 175.8978 | 158.7189 | 153.1048 | 167.0767 | 166.4912 | 181.0857 | 184.6120 | 194.9008  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2125.2760 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1161.2944 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 245.8579  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3607.4283 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1161.2944          | 0.2160                        | 250.8396 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2125.2760          | 0.2160                        | 459.0596 (264)           |
| Space and water heating                                                                           |                    |                               | 709.8992 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 245.8579           | 0.5190                        | 127.6002 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 876.4244 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.2840 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3877 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7284 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.2840 * 1.00) + 2.3877 + 0.7284, rounded to 2 d.p. |                    |                               | 16.4000 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000914                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.13_1B |                |            |
| Property                           | A_1_14.13_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.96        | TER            | 16.40      |
| Environmental                      | 90 B                                | % DER<TER     | 8.78         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.73                                | DFEE          | 34.30        | TFEE           | 33.83      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -1.40        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 53 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.40 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.96 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)33.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)34.3 kWh/m<sup>2</sup>/yrFail  
Excess energy =0.5 kWh/m<sup>2</sup>/yr (1.5%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

|                           |      |
|---------------------------|------|
| Secondary heating system: | None |
|---------------------------|------|

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                    |      |
|-----------------------------------|------------------------------------|------|
| Overheating risk (Thames Valley): | High                               | Fail |
| Based on:                         |                                    |      |
| Overshading:                      | Average                            |      |
| Windows facing South West:        | 13.20 m <sup>2</sup> , No overhang |      |
| Windows facing North West:        | 12.00 m <sup>2</sup> , No overhang |      |
| Air change rate:                  | 2.00 ach                           |      |
| Blinds/curtains:                  | None                               |      |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4400 (1b)              | x 2.5000 (2b)                   | = 133.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 2 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1275 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371 | 0.1211 | 0.1211 | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503 | 0.2344 | 0.2344 | 0.2312 | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K         | K-value<br>kJ/m2K | A x K<br>kJ/K |         |      |
|------------------------------------------------------------|-------------|----------------|---------------|------------------|----------------------|-------------------|---------------|---------|------|
| Opening Type 1 (Uw = 1.00)                                 |             |                | 25.2000       | 0.9615           | 24.2308              |                   | (27)          |         |      |
| External Wall 1                                            | 40.0425     | 25.2000        | 14.8425       | 0.1600           | 2.3748               |                   | (29a)         |         |      |
| Total net area of external elements Aum(A, m2)             |             |                | 40.0425       |                  |                      |                   | (31)          |         |      |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                |               |                  | (26)...(30) + (32) = | 26.6056           | (33)          |         |      |
| Party Floor 1                                              |             |                | 53.4400       |                  |                      |                   | (32d)         |         |      |
| Party Ceilings 1                                           |             |                | 53.4400       |                  |                      |                   | (32b)         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |               |                  |                      |                   | 100.0000      | (35)    |      |
| Thermal bridges (Default value 0.150 * total exposed area) |             |                |               |                  |                      |                   | 6.0064        | (36)    |      |
| Total fabric heat loss                                     |             |                |               |                  |                      |                   | (33) + (36) = | 32.6119 | (37) |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 12.1600 | 12.0195 | 11.8790 | 11.1763 | 11.0358 | 10.3331 | 10.3331 | 10.1926 | 10.6142 | 11.0358 | 11.3168 | 11.5979 (38) |
| Heat transfer coeff                                                 | 44.7720 | 44.6314 | 44.4909 | 43.7883 | 43.6477 | 42.9451 | 42.9451 | 42.8045 | 43.2261 | 43.6477 | 43.9288 | 44.2098 (39) |
| Average = Sum(39)m / 12 =                                           |         |         |         |         |         |         |         |         |         |         |         | 43.7531 (39) |
| HLP                                                                 | 0.8378  | 0.8352  | 0.8325  | 0.8194  | 0.8168  | 0.8036  | 0.8036  | 0.8010  | 0.8089  | 0.8168  | 0.8220  | 0.8273 (40)  |
| HLP (average)                                                       |         |         |         |         |         |         |         |         |         |         |         | 0.8187 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |                                   |          |          |         |         |         |         |         |         |          |          |               |
|------------------------------------------|-----------------------------------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|---------------|
| Assumed occupancy                        |                                   |          |          |         |         |         |         |         |         |          |          | 1.7915 (42)   |
| Average daily hot water use (litres/day) |                                   |          |          |         |         |         |         |         |         |          |          | 76.7487 (43)  |
|                                          | Jan                               | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec           |
| Daily hot water use                      | 84.4236                           | 81.3536  | 78.2837  | 75.2137 | 72.1438 | 69.0738 | 69.0738 | 72.1438 | 75.2137 | 78.2837  | 81.3536  | 84.4236 (44)  |
| Energy content (annual)                  | 125.1977                          | 109.4987 | 112.9929 | 98.5099 | 94.5226 | 81.5658 | 75.5827 | 86.7323 | 87.7681 | 102.2853 | 111.6524 | 121.2473 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | Total = Sum(45)m = 1207.5558 (45) |          |          |         |         |         |         |         |         |          |          |               |
|                                          | 18.7797                           | 16.4248  | 16.9489  | 14.7765 | 14.1784 | 12.2349 | 11.3374 | 13.0098 | 13.1652 | 15.3428  | 16.7479  | 18.1871 (46)  |
| Water storage loss:                      |                                   |          |          |         |         |         |         |         |         |          |          |               |
| Store volume                             |                                   |          |          |         |         |         |         |         |         |          |          | 110.0000 (47) |



|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |             |      |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|-------------|------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                               |             |          |          |             |      |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                               |             |          |          | 0.0152 (51) |      |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                               |             |          |          | 1.0294 (52) |      |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                               |             |          |          | 0.6000 (53) |      |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                               |             |          |          | 1.0327 (55) |      |
| Total storage loss                                              |          |          |          |          |          |          |          |                               |             |          |          |             |      |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817     | 32.0144  | 30.9817  | 32.0144     | (56) |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                               |             |          |          |             |      |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817     | 32.0144  | 30.9817  | 32.0144     | (57) |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624     | (59) |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                               |             |          |          |             |      |
|                                                                 | 180.4745 | 159.4261 | 168.2697 | 152.0036 | 149.7994 | 135.0595 | 130.8595 | 142.0091                      | 141.2618    | 157.5621 | 165.1461 | 176.5241    | (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   |                               | 0.0000      | 0.0000   | 0.0000   | 0.0000      | (63) |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000      | (63) |
| Output from w/h                                                 | 180.4745 | 159.4261 | 168.2697 | 152.0036 | 149.7994 | 135.0595 | 130.8595 | 142.0091                      | 141.2618    | 157.5621 | 165.1461 | 176.5241    | (64) |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1858.3955   | (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                               |             |          |          |             |      |
|                                                                 | 85.8497  | 76.3503  | 81.7916  | 75.5495  | 75.6502  | 69.9156  | 69.3527  | 73.0599                       | 71.9779     | 78.2313  | 79.9194  | 84.5362     | (65) |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9215  | 12.3649  | 10.0558  | 7.6129   | 5.6907   | 4.8044   | 5.1913   | 6.7478   | 9.0569   | 11.4999  | 13.4220  | 14.3084 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.1568 | 157.7772 | 153.6938 | 145.0007 | 134.0273 | 123.7138 | 116.8237 | 115.2033 | 119.2867 | 127.9798 | 138.9532 | 149.2667 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 (71) |
| Water heating gains (Table 5)                                                       | 115.3894 | 113.6165 | 109.9349 | 104.9298 | 101.6804 | 97.1050  | 93.2160  | 98.1988  | 99.9692  | 105.1496 | 110.9991 | 113.6239 (72) |
| Total internal gains                                                                | 335.3405 | 333.6315 | 323.5574 | 307.4163 | 291.2713 | 275.4960 | 265.1039 | 270.0228 | 278.1857 | 294.5021 | 313.2472 | 327.0719 (73) |

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|
| Southwest | 13.2000    | 36.7938                        | 0.5000                            | 0.8000                             | 0.7700                       | 134.6301 (79) |
| Northwest | 12.0000    | 11.2829                        | 0.5000                            | 0.8000                             | 0.7700                       | 37.5316 (81)  |

|                        |         |         |         |         |         |         |         |         |         |                           |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| MIT                    | 19.8806 | 20.2358 | 20.5831 | 20.8457 | 20.9549 | 20.9903 | 20.9975 | 20.9961 | 20.9705 | 20.7898                   | 20.3127 | 19.8086 (87) |
| Th 2                   | 20.2207 | 20.2230 | 20.2252 | 20.2366 | 20.2388 | 20.2502 | 20.2502 | 20.2525 | 20.2457 | 20.2388                   | 20.2343 | 20.2298 (88) |
| util rest of house     |         |         |         |         |         |         |         |         |         |                           |         |              |
|                        | 0.8728  | 0.7879  | 0.6659  | 0.5027  | 0.3532  | 0.2337  | 0.1588  | 0.1840  | 0.3317  | 0.5878                    | 0.8018  | 0.8905 (89)  |
| MIT 2                  | 18.7390 | 19.2329 | 19.7046 | 20.0553 | 20.1907 | 20.2415 | 20.2485 | 20.2497 | 20.2178 | 19.9967                   | 19.3578 | 18.6447 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.4527 (91)  |
| MIT                    | 19.2558 | 19.6869 | 20.1023 | 20.4131 | 20.5366 | 20.5805 | 20.5876 | 20.5876 | 20.5585 | 20.3557                   | 19.7901 | 19.1715 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |         |                           |         | 0.0000       |
| adjusted MIT           | 19.2558 | 19.6869 | 20.1023 | 20.4131 | 20.5366 | 20.5805 | 20.5876 | 20.5876 | 20.5585 | 20.3557                   | 19.7901 | 19.1715 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8556   | 0.7748   | 0.6620   | 0.5092   | 0.3647   | 0.2470   | 0.1734   | 0.1998   | 0.3476   | 0.5931       | 0.7895   | 0.8734 (94)   |
| Useful gains         | 434.2355 | 495.3951 | 513.0252 | 469.5949 | 375.8212 | 254.8781 | 170.8091 | 178.5453 | 273.1204 | 380.3549     | 411.9228 | 413.0786 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 669.5997 | 659.9589 | 605.1768 | 504.1389 | 385.6985 | 256.8315 | 171.2459 | 179.2467 | 279.1775 | 425.8145     | 557.4598 | 661.8895 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 175.1110 | 110.5869 | 68.5608  | 24.8717  | 7.3487   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 33.8219      | 104.7867 | 185.1153 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 710.2030 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 13.2897 (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 710.2030 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 745.7132 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1858.3955 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1951.3153 (310a) |
| Electricity used for heat distribution                                                  | 26.9703 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 85.5708 (330a)   |
| Total electricity for the above, kWh/year                                               | 85.5708 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 245.8579 (332)   |
| Total delivered energy for all uses                                                     | 3028.4571 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2838.9773          | 0.2160                        | 613.2191 (367)           |
| Electrical energy for heat distribution                                                    | 26.9703            | 0.5190                        | 13.9976 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 627.2167 (373)           |
| Space and water heating                                                                    |                    |                               | 627.2167 (376)           |
| Pumps and fans                                                                             | 85.5708            | 0.5190                        | 44.4112 (378)            |
| Energy for lighting                                                                        | 245.8579           | 0.5190                        | 127.6002 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 799.2282 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.9600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 14.9600 ZC1 |
| Total Floor Area                                                                | TFA | 53.4400     |
| Assumed number of occupants                                                     | N   | 1.7915      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.3157 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.0314 ZC3  |
| Total CO2 emissions                                                             |     | 35.3071 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 35.3071 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 53.4400 (1b)              | x 2.5000 (2b)                   | = 133.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 53.4400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 133.6000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | +                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             |                 | Air changes per hour    |
| Pressure test                                                             |                 |                      |                             | 20.0000 / (5) = | 0.1497 (8)              |
| Measured/design AP50                                                      |                 |                      |                             |                 | Yes                     |
| Infiltration rate                                                         |                 |                      |                             |                 | 5.0000                  |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0.3997 (18)             |
|                                                                           |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3397 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4332 | 0.4247 | 0.4162 | 0.3737 | 0.3652 | 0.3228 | 0.3228 | 0.3143 | 0.3397 | 0.3652 | 0.3822 | 0.3992 (22b) |
| Effective ac    | 0.5938 | 0.5902 | 0.5866 | 0.5698 | 0.5667 | 0.5521 | 0.5521 | 0.5494 | 0.5577 | 0.5667 | 0.5730 | 0.5797 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 13.3600                   | 1.3258                        | 17.7121      |                                | (27)          |
| External Wall 1                                                     | 40.0425                 | 13.3600                    | 26.6825                   | 0.1800                        | 4.8029       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 40.0425                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 22.5150      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 2.0021 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 24.5171 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 26.1804                 | 26.0197                    | 25.8623                   | 25.1228                       | 24.9845      | 24.3404                        | 24.3404       |
| Heat transfer coeff                                                 | 50.6975                 | 50.5368                    | 50.3794                   | 49.6399                       | 49.5016      | 48.8575                        | 48.8575       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 48.7382                        | 49.1056       |
|                                                                     |                         |                            |                           |                               |              | 49.5016                        | 49.7814       |
|                                                                     |                         |                            |                           |                               |              | 50.0741                        | 50.0741 (39)  |
|                                                                     |                         |                            |                           |                               |              | 49.6392                        | 49.6392 (39)  |
| HLP                                                                 | 0.9487                  | 0.9457                     | 0.9427                    | 0.9289                        | 0.9263       | 0.9142                         | 0.9142        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.9120                         | 0.9189        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 30            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7915 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 76.7487 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 84.4236  | 81.3536  | 78.2837  | 75.2137 | 72.1438 | 69.0738 | 69.0738 | 72.1438 | 75.2137 | 78.2837            | 81.3536  | 84.4236 (44)   |
| Energy conte                                                | 125.1977 | 109.4987 | 112.9929 | 98.5099 | 94.5226 | 81.5658 | 75.5827 | 86.7323 | 87.7681 | 102.2853           | 111.6524 | 121.2473 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1207.5558 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.7797  | 16.4248  | 16.9489  | 14.7765 | 14.1784 | 12.2349 | 11.3374 | 13.0098 | 13.1652 | 15.3428            | 16.7479  | 18.1871 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                                   | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 171.7926 | 151.5844 | 159.5878 | 143.6018 | 141.1175 | 126.6577 | 122.1776 | 133.3272                                  | 132.8600 | 148.8802 | 156.7443 | 167.8422 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 171.7926 | 151.5844 | 159.5878 | 143.6018 | 141.1175 | 126.6577 | 122.1776 | 133.3272                                  | 132.8600 | 148.8802 | 156.7443 | 167.8422 (64)  |
|                                                                 | 78.9042  | 70.0769  | 74.8460  | 68.8280  | 68.7047  | 63.1941  | 62.4072  | 66.1144                                   | 65.2564  | 71.2858  | 73.1979  | 77.5906 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |          |          | 1756.1732 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | 89.5762  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.9215  | 12.3649  | 10.0558  | 7.6129   | 5.6907   | 4.8044   | 5.1913   | 6.7478   | 9.0569   | 11.4999  | 13.4220  | 14.3084  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 156.1568 | 157.7772 | 153.6938 | 145.0007 | 134.0273 | 123.7138 | 116.8237 | 115.2033 | 119.2867 | 127.9798 | 138.9532 | 149.2667 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | 31.9576  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | -71.6610 | (71) |
| Water heating gains (Table 5)                                                       | 106.0540 | 104.2811 | 100.5995 | 95.5945  | 92.3450  | 87.7696  | 83.8806  | 88.8634  | 90.6339  | 95.8142  | 101.6637 | 104.2885 | (72) |
| Total internal gains                                                                | 329.0051 | 327.2961 | 317.2220 | 301.0810 | 284.9359 | 269.1606 | 258.7685 | 263.6874 | 271.8503 | 288.1667 | 306.9119 | 320.7365 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          |          | Access<br>factor<br>Table 6d |      |  | Gains<br>W |      |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|----------|------------------------------|------|--|------------|------|
| Southwest   |          |          |          |          | 7.0000     | 36.7938                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       |      |  | 78.7127    | (79) |
| Northwest   |          |          |          |          | 6.3600     | 11.2829                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       |      |  | 21.9306    | (81) |
|             |          |          |          |          |            |                                |                                   |                                    |          |          |          |                              |      |  |            |      |
| Solar gains | 100.6434 | 178.7173 | 263.8777 | 359.3889 | 432.1477   | 442.0436                       | 420.7584                          | 364.4865                           | 296.6400 | 202.7377 | 121.8741 | 85.2713                      | (83) |  |            |      |
| Total gains | 429.6485 | 506.0134 | 581.0997 | 660.4699 | 717.0835   | 711.2042                       | 679.5269                          | 628.1739                           | 568.4904 | 490.9044 | 428.7860 | 406.0078                     | (84) |  |            |      |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 73.2011 | 73.4338 | 73.6633 | 74.7606 | 74.9696 | 75.9579 | 75.9579 | 76.1438 | 75.5741 | 74.9696 | 74.5481 | 74.1124 |              |
| alpha                                                                       | 5.8801  | 5.8956  | 5.9109  | 5.9840  | 5.9980  | 6.0639  | 6.0639  | 6.0763  | 6.0383  | 5.9980  | 5.9699  | 5.9408  |              |
| util living area                                                            | 0.9908  | 0.9761  | 0.9334  | 0.8131  | 0.6251  | 0.4380  | 0.3162  | 0.3565  | 0.5851  | 0.8767  | 0.9773  | 0.9931  | (86)         |
| MIT                                                                         | 20.2320 | 20.4164 | 20.6565 | 20.8836 | 20.9778 | 20.9978 | 20.9997 | 20.9995 | 20.9887 | 20.8453 | 20.5005 | 20.1991 | (87)         |
| Th 2                                                                        | 20.1263 | 20.1289 | 20.1313 | 20.1430 | 20.1452 | 20.1554 | 20.1554 | 20.1573 | 20.1515 | 20.1452 | 20.1408 | 20.1362 | (88)         |
| util rest of house                                                          | 0.9880  | 0.9694  | 0.9163  | 0.7759  | 0.5732  | 0.3810  | 0.2556  | 0.2914  | 0.5177  | 0.8402  | 0.9698  | 0.9910  | (89)         |
| MIT 2                                                                       | 19.1167 | 19.3827 | 19.7186 | 20.0206 | 20.1264 | 20.1541 | 20.1553 | 20.1571 | 20.1438 | 19.9841 | 19.5152 | 19.0767 | (90)         |
| Living area fraction                                                        | 19.6216 | 19.8506 | 20.1432 | 20.4112 | 20.5118 | 20.5360 | 20.5376 | 20.5384 | 20.5262 | 20.3739 | 19.9612 | 19.5848 | (91)         |
| MIT                                                                         | 19.6216 | 19.8506 | 20.1432 | 20.4112 | 20.5118 | 20.5360 | 20.5376 | 20.5384 | 20.5262 | 20.3739 | 19.9612 | 19.5848 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.6216 | 19.8506 | 20.1432 | 20.4112 | 20.5118 | 20.5360 | 20.5376 | 20.5384 | 20.5262 | 20.3739 | 19.9612 | 19.5848 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 423.6432 | 489.2309 | 532.6123 | 520.5215 | 427.2572 | 289.2708 | 192.3135 | 201.5614 | 311.4837 | 417.6618 | 415.0099 | 401.6834  | (94)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 776.7653 | 755.5568 | 687.3341 | 571.4150 | 436.1980 | 290.0179 | 192.3790 | 201.6990 | 315.5642 | 483.8240 | 640.2508 | 770.3798  | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 262.7229 | 178.9710 | 115.1130 | 36.6433  | 6.6519   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 49.2247  | 162.1735 | 274.3102  | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1085.8103 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 20.3183   | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1161.2944 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 262.7229 | 178.9710 | 115.1130 | 36.6433  | 6.6519   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 49.2247  | 162.1735 | 274.3102  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 280.9870 | 191.4128 | 123.1155 | 39.1907  | 7.1143   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 52.6467  | 173.4476 | 293.3798  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 171.7926 | 151.5844 | 159.5878 | 143.6018 | 141.1175 | 126.6577 | 122.1776 | 133.3272 | 132.8600 | 148.8802 | 156.7443 | 167.8422  | (64)            |
| Efficiency of water heater (217)m                                     | 85.9439  | 85.2577  | 83.9598  | 81.7653  | 80.2270  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 82.2153  | 84.9047  | 86.1167   | (217)           |
| Fuel for water heating, kWh/month                                     | 199.8893 | 177.7957 | 190.0764 | 175.6267 | 175.8978 | 158.7189 | 153.1048 | 167.0767 | 166.4912 | 181.0857 | 184.6120 | 194.9008  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2125.2760 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1161.2944 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 245.8579  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3607.4283 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1161.2944          | 0.2160                        | 250.8396 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2125.2760          | 0.2160                        | 459.0596 (264)           |
| Space and water heating                                                                           |                    |                               | 709.8992 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 245.8579           | 0.5190                        | 127.6002 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 876.4244 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.2840 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3877 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7284 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.2840 * 1.00) + 2.3877 + 0.7284, rounded to 2 d.p. |                    |                               | 16.4000 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000942                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.14_2B |                |            |
| Property                           | A_1_14.14_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 14.41        | TER            | 15.55      |
| Environmental                      | 89 B                                | % DER<TER     | 7.34         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.86                                | DFEE          | 35.32        | TFEE           | 36.55      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 3.36         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 69 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.55 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.41 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)36.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)35.3 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 2.40 m <sup>2</sup> , No overhang  |
| Windows facing North West: | 15.60 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 18.0000              | 1.3258           | 23.8636      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 36.8672       | 18.0000        | 18.8672              | 0.1600           | 3.0188       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 36.8672              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...(30) + (32) = |                  | 26.8824      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 68.8700              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 68.8700              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                      |                  |              |                   | 5.5301 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                      |                  |              |                   | 32.4125 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 15.6710       | 15.4899        | 15.3088              | 14.4033          | 14.2222      | 13.3167           | 13.3167       | 13.1356 | 13.6789 | 14.2222 | 14.5844 | 14.9466 (38) |
| Heat transfer coeff                                                 | 48.0835       | 47.9024        | 47.7213              | 46.8158          | 46.6347      | 45.7291           | 45.7291       | 45.5480 | 46.0913 | 46.6347 | 46.9969 | 47.3591 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                      |                  |              |                   |               |         |         |         |         | 46.7705 (39) |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.6982        | 0.6955         | 0.6929               | 0.6798           | 0.6771       | 0.6640            | 0.6640        | 0.6614  | 0.6693  | 0.6771  | 0.6824  | 0.6877 (40)  |
| HLP (average)                                                       |               |                |                      |                  |              |                   |               |         |         |         |         | 0.6791 (40)  |
| Days in month                                                       | 31            | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.2184 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 86.8865 (43)                      |
| Daily hot water use                      | Jan 95.5752 | Feb 92.0997 | Mar 88.6243 | Apr 85.1488 | May 81.6734 | Jun 78.1979 | Jul 78.1979 | Aug 81.6734 | Sep 85.1488 | Oct 88.6243 | Nov 92.0997 | Dec 95.5752 (44)                  |
| Energy conte                             | 141.7353    | 123.9626    | 127.9183    | 111.5222    | 107.0082    | 92.3400     | 85.5666     | 98.1889     | 99.3616     | 115.7963    | 126.4008    | 137.2630 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 21.2603     | 18.5944     | 19.1877     | 16.7283     | 16.0512     | 13.8510     | 12.8350     | 14.7283     | 14.9042     | 17.3695     | 18.9601     | 20.5895 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|-----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)                             |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)                             |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)                             |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)                             |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)                            |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)                            |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)                            |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (62)                           |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)                             |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |                                         | 0.0000 (63)    |
| Output from w/h                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (64)                           |                |
|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          | Total per year (kWh/year) = Sum (64)m = | 2017.9035 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 91.3484  | 81.1595  | 86.7543  | 79.8761  | 79.8017  | 73.4980  | 72.6723  | 76.8692                                   | 75.8327  | 82.7237  | 84.8232  | 89.8614 (65)                            |                |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.3528  | 15.4126  | 12.5344  | 9.4893   | 7.0934   | 5.9885   | 6.4708   | 8.4110   | 11.2892  | 14.3343  | 16.7302  | 17.8351 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 194.6455 | 196.6653 | 191.5754 | 180.7397 | 167.0616 | 154.2061 | 145.6178 | 143.5980 | 148.6878 | 159.5235 | 173.2017 | 186.0572 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 (71) |
| Water heating gains (Table 5)                                                       | 122.7801 | 120.7731 | 116.6052 | 110.9390 | 107.2603 | 102.0805 | 97.6779  | 103.3189 | 105.3231 | 111.1878 | 117.8100 | 120.7815 (72) |
| Total internal gains                                                                | 391.0541 | 389.1266 | 376.9907 | 357.4438 | 337.6910 | 318.5508 | 306.0422 | 311.6036 | 321.5759 | 341.3213 | 364.0176 | 380.9494 (73) |

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 2.4000     | 11.2829                        | 0.3000                            | 0.8000                             | 0.7700                       | 4.5038 (75)  |
| Northwest | 15.6000    | 11.2829                        | 0.3000                            | 0.8000                             | 0.7700                       | 29.2746 (81) |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 39.7861 | 39.9365 | 40.0881 | 40.8635 | 41.0222 | 41.8345 | 41.8345 | 42.0008 | 41.5057                   | 41.0222 | 40.7060 | 40.3947      |
| alpha                                                                       | 3.6524  | 3.6624  | 3.6725  | 3.7242  | 3.7348  | 3.7890  | 3.7890  | 3.8001  | 3.7670                    | 3.7348  | 3.7137  | 3.6930       |
| util living area                                                            | 0.9515  | 0.9340  | 0.8918  | 0.7922  | 0.6384  | 0.4638  | 0.3435  | 0.3889  | 0.6147                    | 0.8372  | 0.9274  | 0.9566 (86)  |
| MIT                                                                         | 19.7735 | 19.9422 | 20.2440 | 20.6215 | 20.8648 | 20.9697 | 20.9925 | 20.9882 | 20.9142                   | 20.6001 | 20.1448 | 19.7495 (87) |
| Th 2                                                                        | 20.3424 | 20.3448 | 20.3471 | 20.3587 | 20.3611 | 20.3727 | 20.3727 | 20.3751 | 20.3681                   | 20.3611 | 20.3564 | 20.3517 (88) |
| util rest of house                                                          | 0.9458  | 0.9264  | 0.8795  | 0.7704  | 0.6054  | 0.4222  | 0.2959  | 0.3384  | 0.5702                    | 0.8147  | 0.9178  | 0.9515 (89)  |
| MIT 2                                                                       | 18.6776 | 18.9213 | 19.3527 | 19.8852 | 20.2069 | 20.3436 | 20.3671 | 20.3658 | 20.2794                   | 19.8672 | 19.2234 | 18.6497 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4703 (91)  |
| MIT                                                                         | 19.1930 | 19.4014 | 19.7719 | 20.2315 | 20.5163 | 20.6381 | 20.6612 | 20.6585 | 20.5779                   | 20.2119 | 19.6567 | 19.1669 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.1930 | 19.4014 | 19.7719 | 20.2315 | 20.5163 | 20.6381 | 20.6612 | 20.6585 | 20.5779                   | 20.2119 | 19.6567 | 19.1669 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9338   | 0.9136   | 0.8673   | 0.7658   | 0.6136   | 0.4400   | 0.3179   | 0.3615   | 0.5854   | 0.8090       | 0.9058   | 0.9401 (94)    |
| Useful gains         | 396.6890 | 418.3012 | 434.4228 | 429.5450 | 374.9991 | 268.4474 | 184.0089 | 191.2303 | 276.6149 | 344.0935     | 368.2206 | 384.0731 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 716.1072 | 694.6529 | 633.3510 | 530.4922 | 411.1458 | 276.1158 | 185.7158 | 193.9656 | 298.5760 | 448.2487     | 590.1262 | 708.8195 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 237.6472 | 185.7083 | 148.0026 | 72.6820  | 26.8931  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 77.4915      | 159.7720 | 241.6113 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1149.8080 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 16.6953 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1149.8080 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1207.2984 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2017.9035 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2118.7987 (310a) |
| Electricity used for heat distribution                                                  | 33.2610 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 115.5294 (330a)  |
| Total electricity for the above, kWh/year                                               | 115.5294 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 306.4556 (332)   |
| Total delivered energy for all uses                                                     | 3748.0821 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3501.1548          | 0.2160                        | 756.2494 (367)           |
| Electrical energy for heat distribution                                                    | 33.2610            | 0.5190                        | 17.2624 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 773.5119 (373)           |
| Space and water heating                                                                    |                    |                               | 773.5119 (376)           |
| Pumps and fans                                                                             | 115.5294           | 0.5190                        | 59.9598 (378)            |
| Energy for lighting                                                                        | 306.4556           | 0.5190                        | 159.0505 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 992.5221 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.4100 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 14.4100 ZC1 |
| Total Floor Area                                                                | TFA | 68.8700     |
| Assumed number of occupants                                                     | N   | 2.2184      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.7479 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5010 ZC3  |
| Total CO2 emissions                                                             |     | 33.6589 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 33.6589 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1162 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.3662 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3112 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3968 | 0.3890 | 0.3813 | 0.3424 | 0.3346 | 0.2957 | 0.2957 | 0.2879 | 0.3112 | 0.3346 | 0.3501 | 0.3657 (22b) |
| Effective ac    | 0.5787 | 0.5757 | 0.5727 | 0.5586 | 0.5560 | 0.5437 | 0.5437 | 0.5414 | 0.5484 | 0.5560 | 0.5613 | 0.5669 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 17.2200                   | 1.3258                        | 22.8295      |                                | (27)          |
| External Wall 1                                                     | 36.8672                 | 17.2200                    | 19.6472                   | 0.1800                        | 3.5365       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 36.8672                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            |                           | (26)...(30) + (32) =          | 26.3660      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.8434 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 28.2094 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 32.8825                 | 32.7087                    | 32.5385                   | 31.7387                       | 31.5891      | 30.8925                        | 30.8925       |
| Heat transfer coeff                                                 | 61.0919                 | 60.9182                    | 60.7479                   | 59.9481                       | 59.7985      | 59.1019                        | 59.1019       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 58.9729                        | 59.3702       |
|                                                                     |                         |                            |                           |                               |              | 59.7985                        | 59.7985       |
|                                                                     |                         |                            |                           |                               |              | 60.1012                        | 60.1012       |
|                                                                     |                         |                            |                           |                               |              | 60.4176                        | 60.4176 (39)  |
|                                                                     |                         |                            |                           |                               |              | 59.9474                        | 59.9474 (39)  |
| HLP                                                                 | 0.8871                  | 0.8845                     | 0.8821                    | 0.8705                        | 0.8683       | 0.8582                         | 0.8582        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.8563                         | 0.8621        |
| Days in month                                                       |                         |                            |                           |                               |              | 0.8683                         | 0.8727        |
|                                                                     |                         |                            |                           |                               |              | 0.8773                         | 0.8773 (40)   |
|                                                                     |                         |                            |                           |                               |              | 0.8704                         | 0.8704 (40)   |
|                                                                     | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 30            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.2184 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.8865 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 95.5752  | 92.0997  | 88.6243  | 85.1488  | 81.6734  | 78.1979 | 78.1979 | 81.6734 | 85.1488 | 88.6243            | 92.0997  | 95.5752 (44)   |
| Energy conte                                                | 141.7353 | 123.9626 | 127.9183 | 111.5222 | 107.0082 | 92.3400 | 85.5666 | 98.1889 | 99.3616 | 115.7963           | 126.4008 | 137.2630 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             | 21.2603  | 18.5944  | 19.1877  | 16.7283  | 16.0512  | 13.8510 | 12.8350 | 14.7283 | 14.9042 | 17.3695            | 18.9601  | 20.5895 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838 | 144.4534 | 162.3912 | 171.4926 | 183.8579 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838 | 144.4534 | 162.3912 | 171.4926 | 183.8579 (64) |
|                                                                 | 84.4029  | 74.8861  | 79.8087  | 73.1546  | 72.8562  | 66.7765  | 65.7268  | 69.9237  | 69.1112  | 75.7782  | 78.1017  | 82.9159 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.3528  | 15.4126  | 12.5344  | 9.4893   | 7.0934   | 5.9885   | 6.4708   | 8.4110   | 11.2892  | 14.3343  | 16.7302  | 17.8351  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 194.6455 | 196.6653 | 191.5754 | 180.7397 | 167.0616 | 154.2061 | 145.6178 | 143.5980 | 148.6878 | 159.5235 | 173.2017 | 186.0572 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | (71) |
| Water heating gains (Table 5)                                                       | 113.4448 | 111.4377 | 107.2698 | 101.6036 | 97.9250  | 92.7452  | 88.3425  | 93.9835  | 95.9878  | 101.8524 | 108.4746 | 111.4461 | (72) |
| Total internal gains                                                                | 384.7187 | 382.7913 | 370.6553 | 351.1084 | 331.3556 | 312.2155 | 299.7068 | 305.2682 | 315.2406 | 334.9860 | 357.6822 | 374.6141 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          |          | 2.3000     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 7.9309 (75)  |               |
| Northwest   |          |          |          |          | 14.9200    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 51.4473 (81) |               |
|             |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 59.3782  | 120.8661 | 217.7623 | 357.6283 | 480.7226   | 512.5011                       | 479.4343                          | 382.2106                           | 265.3468                     | 147.7080 | 74.7132      | 48.4913 (83)  |
| Total gains | 444.0970 | 503.6574 | 588.4176 | 708.7366 | 812.0782   | 824.7166                       | 779.1411                          | 687.4788                           | 580.5873                     | 482.6939 | 432.3954     | 423.1053 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |              | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |              |
| tau                                                                         | 78.2860 | 78.5093 | 78.7293 | 79.7797 | 79.9793 | 80.9219 | 80.9219 | 81.0989 | 80.5562 | 79.9793 | 79.5765 | 79.1596      |              |
| alpha                                                                       | 6.2191  | 6.2340  | 6.2486  | 6.3186  | 6.3320  | 6.3948  | 6.3948  | 6.4066  | 6.3704  | 6.3320  | 6.3051  | 6.2773       |              |
| util living area                                                            | 0.9968  | 0.9923  | 0.9718  | 0.8732  | 0.6639  | 0.4569  | 0.3336  | 0.3940  | 0.6812  | 0.9467  | 0.9924  | 0.9976 (86)  |              |
| MIT                                                                         | 20.1728 | 20.3107 | 20.5570 | 20.8469 | 20.9756 | 20.9980 | 20.9998 | 20.9994 | 20.9796 | 20.7629 | 20.4164 | 20.1492 (87) |              |
| Th 2                                                                        | 20.1785 | 20.1807 | 20.1828 | 20.1927 | 20.1945 | 20.2032 | 20.2032 | 20.2048 | 20.1999 | 20.1945 | 20.1908 | 20.1869 (88) |              |
| util rest of house                                                          | 0.9958  | 0.9899  | 0.9633  | 0.8428  | 0.6131  | 0.4008  | 0.2733  | 0.3262  | 0.6118  | 0.9260  | 0.9895  | 0.9968 (89)  |              |
| MIT 2                                                                       | 19.0713 | 19.2734 | 19.6276 | 20.0250 | 20.1733 | 20.2020 | 20.2031 | 20.2046 | 20.1852 | 19.9277 | 19.4358 | 19.0433 (90) |              |
| Living area fraction                                                        | 19.5893 | 19.7613 | 20.0647 | 20.4116 | 20.5506 | 20.5763 | 20.5778 | 20.5784 | 20.5588 | 20.3205 | 19.8970 | 19.5634 (92) |              |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |              |
| adjusted MIT                                                                | 19.5893 | 19.7613 | 20.0647 | 20.4116 | 20.5506 | 20.5763 | 20.5778 | 20.5784 | 20.5588 | 20.3205 | 19.8970 | 19.5634 (93) |              |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                |  |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|--|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |  |
| Useful gains         | 0.9948   | 0.9884   | 0.9618   | 0.8516   | 0.6360   | 0.4272   | 0.3016   | 0.3581   | 0.6437   | 0.9297   | 0.9882   | 0.9961 (94)    |  |
| Ext temp.            | 441.7998 | 497.7973 | 565.9476 | 603.5537 | 516.4455 | 352.3197 | 235.0179 | 246.1899 | 373.7363 | 448.7727 | 427.3056 | 421.4389 (95)  |  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |  |
| Month fracti         | 934.0525 | 905.3203 | 824.0260 | 690.0980 | 529.2539 | 353.2131 | 235.0951 | 246.4109 | 383.4618 | 581.2710 | 769.1153 | 928.2199 (97)  |  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |  |
| Space heating per m2 | 366.2361 | 273.8554 | 192.0103 | 62.3119  | 9.5295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 98.5788  | 246.1030 | 377.0451 (98)  |  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1625.6699 (98) |  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 23.6049 (99)   |  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1738.6844 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 366.2361 | 273.8554 | 192.0103 | 62.3119  | 9.5295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 98.5788  | 246.1030 | 377.0451  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 391.6963 | 292.8935 | 205.3586 | 66.6437  | 10.1919  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 105.4318 | 263.2117 | 403.2568  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838 | 144.4534 | 162.3912 | 171.4926 | 183.8579  | (64)            |
| Efficiency of water heater (217)m                                     | 86.5585  | 86.1402  | 85.0690  | 82.5789  | 80.3550  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.5306  | 85.7768  | 86.6898   | (216)           |
| Fuel for water heating, kWh/month                                     | 217.5755 | 192.7651 | 205.1430 | 189.6538 | 191.1557 | 172.2203 | 165.6159 | 181.4333 | 181.0193 | 194.4094 | 199.9290 | 212.0871  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2303.0075 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1738.6844 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 306.4556  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4423.1475 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1738.6844          | 0.2160                        | 375.5558 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2303.0075          | 0.2160                        | 497.4496 (264)           |
| Space and water heating                                                                           |                    |                               | 873.0054 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 306.4556           | 0.5190                        | 159.0505 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1070.9809 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.6761 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3094 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5652 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.6761 * 1.00) + 2.3094 + 0.5652, rounded to 2 d.p. |                    |                               | 15.5500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_000986                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | A_1_14.14_2B |                |            |
| Property                           | A_1_14.14_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.86        | TER            | 15.55      |
| Environmental                      | 90 B                                | % DER<TER     | 17.30        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.79                                | DFEE          | 29.02        | TFEE           | 36.55      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 20.59        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 69 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.55 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.86 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)36.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)29.0 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default y-value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 2.40 m <sup>2</sup> , No overhang  |
| Windows facing North West: | 15.60 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2758                       | 0.2726 | 0.2694    | 0.2535 | 0.2503 | 0.2344 | 0.2344                      | 0.2312      | 0.2408 | 0.2503 | 0.2567 | 0.2631 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |               |                | 18.0000              | 0.9615           | 17.3077      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 36.8672       | 18.0000        | 18.8672              | 0.1600           | 3.0188       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 36.8672              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...(30) + (32) = |                  | 20.3264      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 68.8700              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 68.8700              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                      |                  |              |                   | 5.5301 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                      |                  |              |                   | 25.8565 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 15.6710       | 15.4899        | 15.3088              | 14.4033          | 14.2222      | 13.3167           | 13.3167       | 13.1356 | 13.6789 | 14.2222 | 14.5844 | 14.9466 (38) |
| Heat transfer coeff                                                 | 41.5276       | 41.3465        | 41.1654              | 40.2598          | 40.0787      | 39.1732           | 39.1732       | 38.9921 | 39.5354 | 40.0787 | 40.4409 | 40.8031 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                      |                  |              |                   |               |         |         |         |         | 40.2145 (39) |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.6030        | 0.6004         | 0.5977               | 0.5846           | 0.5819       | 0.5688            | 0.5688        | 0.5662  | 0.5741  | 0.5819  | 0.5872  | 0.5925 (40)  |
| HLP (average)                                                       |               |                |                      |                  |              |                   |               |         |         |         |         | 0.5839 (40)  |
| Days in month                                                       | 31            | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                                   |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----------------------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 2.2184 (42)                       |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 86.8865 (43)                      |
| Daily hot water use                      | Jan 95.5752 | Feb 92.0997 | Mar 88.6243 | Apr 85.1488 | May 81.6734 | Jun 78.1979 | Jul 78.1979 | Aug 81.6734 | Sep 85.1488 | Oct 88.6243 | Nov 92.0997 | Dec 95.5752 (44)                  |
| Energy conte                             | 141.7353    | 123.9626    | 127.9183    | 111.5222    | 107.0082    | 92.3400     | 85.5666     | 98.1889     | 99.3616     | 115.7963    | 126.4008    | 137.2630 (45)                     |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |             |             |             |             |             |             |             |             |             |             |             |                                   |
|                                          | 21.2603     | 18.5944     | 19.1877     | 16.7283     | 16.0512     | 13.8510     | 12.8350     | 14.7283     | 14.9042     | 17.3695     | 18.9601     | 20.5895 (46)                      |
| Water storage loss:                      |             |             |             |             |             |             |             |             |             |             |             |                                   |
| Store volume                             |             |             |             |             |             |             |             |             |             |             |             | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------|----------|-----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                           |          |          |          | 0.0152 (51)                             |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                           |          |          |          | 1.0294 (52)                             |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                           |          |          |          | 0.6000 (53)                             |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                           |          |          |          | 1.0327 (55)                             |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)                            |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                   | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)                            |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                   | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)                            |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (62)                           |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)                             |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |          |          |                                         | 0.0000 (63)    |
| Output from w/h                                                 | 197.0121 | 173.8900 | 183.1951 | 165.0159 | 162.2851 | 145.8337 | 140.8434 | 153.4657                                  | 152.8553 | 171.0731 | 179.8944 | 192.5398 (64)                           |                |
|                                                                 |          |          |          |          |          |          |          |                                           |          |          |          | Total per year (kWh/year) = Sum (64)m = | 2017.9035 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                           |          |          |          |                                         |                |
|                                                                 | 91.3484  | 81.1595  | 86.7543  | 79.8761  | 79.8017  | 73.4980  | 72.6723  | 76.8692                                   | 75.8327  | 82.7237  | 84.8232  | 89.8614 (65)                            |                |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.9154   | 0.8768   | 0.7913   | 0.6254   | 0.4442   | 0.2963   | 0.2116   | 0.2490   | 0.4456   | 0.7221       | 0.8729   | 0.9247 (94)   |
| Useful gains         | 409.4972 | 441.6579 | 461.6824 | 435.5748 | 352.4812 | 238.3476 | 160.9204 | 167.8335 | 255.3698 | 347.6074     | 379.5746 | 394.7950 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 637.3224 | 619.8047 | 565.7751 | 469.5988 | 359.8013 | 239.3150 | 161.0923 | 168.1696 | 260.5307 | 396.6799     | 523.7589 | 629.0256 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 169.5020 | 119.7147 | 77.4449  | 24.4973  | 5.4462   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 36.5100      | 103.8127 | 174.2676 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 711.1953 (99) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 10.3266 (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 711.1953 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 746.7551 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2017.9035 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2118.7987 (310a) |
| Electricity used for heat distribution                                                  | 28.6555 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 115.5294 (330a)  |
| Total electricity for the above, kWh/year                                               | 115.5294 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 306.4556 (332)   |
| Total delivered energy for all uses                                                     | 3287.5388 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3016.3723          | 0.2160                        | 651.5364 (367)           |
| Electrical energy for heat distribution                                                    | 28.6555            | 0.5190                        | 14.8722 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 666.4087 (373)           |
| Space and water heating                                                                    |                    |                               | 666.4087 (376)           |
| Pumps and fans                                                                             | 115.5294           | 0.5190                        | 59.9598 (378)            |
| Energy for lighting                                                                        | 306.4556           | 0.5190                        | 159.0505 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 885.4189 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.8600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 12.8600 ZC1 |
| Total Floor Area                                                                | 68.8700     |
| Assumed number of occupants                                                     | 2.2184      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   | 16.7479 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.5010 ZC3  |
| Total CO2 emissions                                                             | 32.1089 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 32.1089 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.8700 (1b)              | x 2.5000 (2b)                   | = 172.1750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.8700                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 172.1750 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1162 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3662 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 2 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3112 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3968 | 0.3890 | 0.3813 | 0.3424 | 0.3346 | 0.2957 | 0.2957 | 0.2879 | 0.3112 | 0.3346 | 0.3501 | 0.3657 (22b) |
| Effective ac    | 0.5787 | 0.5757 | 0.5727 | 0.5586 | 0.5560 | 0.5437 | 0.5437 | 0.5414 | 0.5484 | 0.5560 | 0.5613 | 0.5669 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |               |                  |                              |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------|------------------------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 17.2200       | 1.3258           | 22.8295                      |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 36.8672     | 17.2200        | 19.6472       | 0.1800           | 3.5365                       |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 36.8672       |                  |                              |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               |                  | (26)...(30) + (32) = 26.3660 |                   |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                  |                              |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |               |                  |                              |                   |               | 1.8434 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |               |                  |                              | (33) + (36) =     | 28.2094       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                  |                              |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 32.8825     | 32.7087        | 32.5385       | 31.7387          | 31.5891                      | 30.8925           | 30.8925       | 30.7635       | 31.1608 | 31.5891 | 31.8918 | 32.2082 | (38) |
| Heat transfer coeff                                                 | 61.0919     | 60.9182        | 60.7479       | 59.9481          | 59.7985                      | 59.1019           | 59.1019       | 58.9729       | 59.3702 | 59.7985 | 60.1012 | 60.4176 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                  |                              |                   |               |               |         |         |         | 59.9474 | (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.8871      | 0.8845         | 0.8821        | 0.8705           | 0.8683                       | 0.8582            | 0.8582        | 0.8563        | 0.8621  | 0.8683  | 0.8727  | 0.8773  | (40) |
| HLP (average)                                                       |             |                |               |                  |                              |                   |               |               |         |         |         | 0.8704  | (40) |
| Days in month                                                       | 31          | 28             | 31            | 30               | 31                           | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.2184 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.8865 (43)   |
| Daily hot water use                                         | 95.5752  | 92.0997  | 88.6243  | 85.1488  | 81.6734  | 78.1979 | 78.1979 | 81.6734 | 85.1488 | 88.6243            | 92.0997  | 95.5752 (44)   |
| Energy conte                                                | 141.7353 | 123.9626 | 127.9183 | 111.5222 | 107.0082 | 92.3400 | 85.5666 | 98.1889 | 99.3616 | 115.7963           | 126.4008 | 137.2630 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1367.0637 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.2603  | 18.5944  | 19.1877  | 16.7283  | 16.0512  | 13.8510 | 12.8350 | 14.7283 | 14.9042 | 17.3695            | 18.9601  | 20.5895 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838                      | 144.4534    | 162.3912 | 171.4926 | 183.8579 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
|                                                                 | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838                      | 144.4534    | 162.3912 | 171.4926 | 183.8579 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1915.6811 (64) |
|                                                                 | 84.4029  | 74.8861  | 79.8087  | 73.1546  | 72.8562  | 66.7765  | 65.7268  | 69.9237                       | 69.1112     | 75.7782  | 78.1017  | 82.9159 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 | 110.9190 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 17.3528  | 15.4126  | 12.5344  | 9.4893   | 7.0934   | 5.9885   | 6.4708   | 8.4110   | 11.2892  | 14.3343  | 16.7302  | 17.8351 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 194.6455 | 196.6653 | 191.5754 | 180.7397 | 167.0616 | 154.2061 | 145.6178 | 143.5980 | 148.6878 | 159.5235 | 173.2017 | 186.0572 (68) |
| Pumps, fans                                                                         | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919  | 34.0919 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 | -88.7352 (71) |
| Total internal gains                                                                | 113.4448 | 111.4377 | 107.2698 | 101.6036 | 97.9250  | 92.7452  | 88.3425  | 93.9835  | 95.9878  | 101.8524 | 108.4746 | 111.4461 (72) |
|                                                                                     | 384.7187 | 382.7913 | 370.6553 | 351.1084 | 331.3556 | 312.2155 | 299.7068 | 305.2682 | 315.2406 | 334.9860 | 357.6822 | 374.6141 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          |          | 2.3000     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 7.9309 (75)  |               |
| Northwest   |          |          |          |          | 14.9200    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 51.4473 (81) |               |
|             |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 59.3782  | 120.8661 | 217.7623 | 357.6283 | 480.7226   | 512.5011                       | 479.4343                          | 382.2106                           | 265.3468                     | 147.7080 | 74.7132      | 48.4913 (83)  |
| Total gains | 444.0970 | 503.6574 | 588.4176 | 708.7366 | 812.0782   | 824.7166                       | 779.1411                          | 687.4788                           | 580.5873                     | 482.6939 | 432.3954     | 423.1053 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 78.2860 | 78.5093 | 78.7293 | 79.7797 | 79.9793 | 80.9219 | 80.9219 | 81.0989 | 80.5562                   | 79.9793 | 79.5765 | 79.1596      |
| alpha                                                                       | 6.2191  | 6.2340  | 6.2486  | 6.3186  | 6.3320  | 6.3948  | 6.3948  | 6.4066  | 6.3704                    | 6.3320  | 6.3051  | 6.2773       |
| util living area                                                            |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | 0.9968  | 0.9923  | 0.9718  | 0.8732  | 0.6639  | 0.4569  | 0.3336  | 0.3940  | 0.6812                    | 0.9467  | 0.9924  | 0.9976 (86)  |
| MIT                                                                         | 20.1728 | 20.3107 | 20.5570 | 20.8469 | 20.9756 | 20.9980 | 20.9998 | 20.9994 | 20.9796                   | 20.7629 | 20.4164 | 20.1492 (87) |
| Th 2                                                                        | 20.1785 | 20.1807 | 20.1828 | 20.1927 | 20.1945 | 20.2032 | 20.2032 | 20.2048 | 20.1999                   | 20.1945 | 20.1908 | 20.1869 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | 0.9958  | 0.9899  | 0.9633  | 0.8428  | 0.6131  | 0.4008  | 0.2733  | 0.3262  | 0.6118                    | 0.9260  | 0.9895  | 0.9968 (89)  |
| MIT 2                                                                       | 19.0713 | 19.2734 | 19.6276 | 20.0250 | 20.1733 | 20.2020 | 20.2031 | 20.2046 | 20.1852                   | 19.9277 | 19.4358 | 19.0433 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4703 (91)  |
| MIT                                                                         | 19.5893 | 19.7613 | 20.0647 | 20.4116 | 20.5506 | 20.5763 | 20.5778 | 20.5784 | 20.5588                   | 20.3205 | 19.8970 | 19.5634 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.5893 | 19.7613 | 20.0647 | 20.4116 | 20.5506 | 20.5763 | 20.5778 | 20.5784 | 20.5588                   | 20.3205 | 19.8970 | 19.5634 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9948   | 0.9884   | 0.9618   | 0.8516   | 0.6360   | 0.4272   | 0.3016   | 0.3581   | 0.6437   | 0.9297       | 0.9882   | 0.9961 (94)    |
| Ext temp.            | 441.7998 | 497.7973 | 565.9476 | 603.5537 | 516.4455 | 352.3197 | 235.0179 | 246.1899 | 373.7363 | 448.7727     | 427.3056 | 421.4389 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 934.0525 | 905.3203 | 824.0260 | 690.0980 | 529.2539 | 353.2131 | 235.0951 | 246.4109 | 383.4618 | 581.2710     | 769.1153 | 928.2199 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 366.2361 | 273.8554 | 192.0103 | 62.3119  | 9.5295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 98.5788      | 246.1030 | 377.0451 (98)  |
|                      |          |          |          |          |          |          |          |          |          |              |          | 1625.6699 (98) |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 23.6049 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1738.6844 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 366.2361 | 273.8554 | 192.0103 | 62.3119  | 9.5295   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 98.5788  | 246.1030 | 377.0451  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 391.6963 | 292.8935 | 205.3586 | 66.6437  | 10.1919  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 105.4318 | 263.2117 | 403.2568  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 188.3302 | 166.0483 | 174.5132 | 156.6141 | 153.6032 | 137.4318 | 132.1615 | 144.7838 | 144.4534 | 162.3912 | 171.4926 | 183.8579  | (64)            |
| Efficiency of water heater                                            | 86.5585  | 86.1402  | 85.0690  | 82.5789  | 80.3550  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.5306  | 85.7768  | 86.6898   | (216)           |
| Fuel for water heating, kWh/month                                     | 217.5755 | 192.7651 | 205.1430 | 189.6538 | 191.1557 | 172.2203 | 165.6159 | 181.4333 | 181.0193 | 194.4094 | 199.9290 | 212.0871  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2303.0075 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1738.6844 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 306.4556  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4423.1475 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1738.6844          | 0.2160                        | 375.5558 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2303.0075          | 0.2160                        | 497.4496 (264)           |
| Space and water heating                                                                           |                    |                               | 873.0054 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 306.4556           | 0.5190                        | 159.0505 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1070.9809 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.6761 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3094 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5652 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.6761 * 1.00) + 2.3094 + 0.5652, rounded to 2 d.p. |                    |                               | 15.5500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001014                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.09_1B |                |            |
| Property                           | B_2_13.09_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 14.30        | TER            | 15.85      |
| Environmental                      | 90 B                                | % DER<TER     | 9.81         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.77                                | DFEE          | 33.30        | TFEE           | 34.82      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 4.35         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.85 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.30 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)34.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)33.3 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.5300 (1b)              | x 2.5000 (2b)                   | = 153.8250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.5300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 153.8250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 14.4000              | 1.3258           | 19.0909      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 30.3761       | 14.4000        | 15.9761              | 0.1600           | 2.5562       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 30.3761              |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26)...(30) + (32) = |                  | 21.6471      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 61.5300              |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 61.4400              |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                      |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                      |                  |              |                   | 4.5564 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                      |                  |              |                   | 26.2035 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                      |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 13.2727       | 13.1252        | 12.9777              | 12.2400          | 12.0925      | 11.3549           | 11.3549       | 11.2074 | 11.6499 | 12.0925 | 12.3876 | 12.6826 (38) |
| Heat transfer coeff                                                 | 39.4762       | 39.3287        | 39.1812              | 38.4435          | 38.2960      | 37.5584           | 37.5584       | 37.4109 | 37.8534 | 38.2960 | 38.5911 | 38.8861 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                      |                  |              |                   |               |         |         |         |         | 38.4067 (39) |
|                                                                     | Jan           | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.6416        | 0.6392         | 0.6368               | 0.6248           | 0.6224       | 0.6104            | 0.6104        | 0.6080  | 0.6152  | 0.6224  | 0.6272  | 0.6320 (40)  |
| HLP (average)                                                       |               |                |                      |                  |              |                   |               |         |         |         |         | 0.6242 (40)  |
| Days in month                                                       | 31            | 28             | 31                   | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |         |         |          |          | 2.0245 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |         |         |          |          | 82.2830 (43)                      |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Daily hot water use                      | 90.5113  | 87.2200  | 83.9286  | 80.6373  | 77.3460  | 74.0547 | 74.0547 | 77.3460 | 80.6373 | 83.9286  | 87.2200  | 90.5113 (44)                      |
| Energy content (annual)                  | 134.2256 | 117.3946 | 121.1407 | 105.6134 | 101.3386 | 87.4475 | 81.0329 | 92.9865 | 94.0970 | 109.6610 | 119.7036 | 129.9903 (45)                     |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1294.6317 (45) |
|                                          | 20.1338  | 17.6092  | 18.1711  | 15.8420  | 15.2008  | 13.1171 | 12.1549 | 13.9480 | 14.1146 | 16.4492  | 17.9555  | 19.4986 (46)                      |
| Water storage loss:                      |          |          |          |          |          |         |         |         |         |          |          |                                   |
| Store volume                             |          |          |          |          |          |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |      |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |                |      |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)    |      |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)    |      |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)    |      |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)    |      |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                |      |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144        | (56) |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                |      |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144        | (57) |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624        | (59) |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                |      |
|                                                                 | 189.5024 | 167.3220 | 176.4175 | 159.1071 | 156.6154 | 140.9412 | 136.3097 | 148.2633 | 147.5907 | 164.9378 | 173.1973 | 185.2671       | (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000         | (63) |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |      |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                |      |
|                                                                 | 189.5024 | 167.3220 | 176.4175 | 159.1071 | 156.6154 | 140.9412 | 136.3097 | 148.2633 | 147.5907 | 164.9378 | 173.1973 | 185.2671       | (64) |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          | 1945.4715 (64) |      |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                |      |
|                                                                 | 88.8515  | 78.9756  | 84.5007  | 77.9114  | 77.9165  | 71.8712  | 71.1649  | 75.1394  | 74.0822  | 80.6837  | 82.5964  | 87.4432        | (65) |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 855.8066  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 898.5970  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1945.4715 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2042.7451 | (310a) |
| Electricity used for heat distribution                                                  | 29.4134   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 98.5249   | (330a) |
| Total electricity for the above, kWh/year                                               | 98.5249   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 278.3410  | (332)  |
| Total delivered energy for all uses                                                     | 3318.2080 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3096.1495          | 0.2160                        | 668.7683 (367)           |
| Electrical energy for heat distribution                                                    | 29.4134            | 0.5190                        | 15.2656 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 684.0339 (373)           |
| Space and water heating                                                                    |                    |                               | 684.0339 (376)           |
| Pumps and fans                                                                             | 98.5249            | 0.5190                        | 51.1344 (378)            |
| Energy for lighting                                                                        | 278.3410           | 0.5190                        | 144.4590 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 879.6273 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.3000 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 14.3000 | ZC1 |
| Total Floor Area                                                                | TFA | 61.5300 |     |
| Assumed number of occupants                                                     | N   | 2.0245  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.0260 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.7237  | ZC3 |
| Total CO2 emissions                                                             |     | 34.0497 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 34.0497 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.5300 (1b)              | x 2.5000 (2b)                   | = 153.8250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.5300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 153.8250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1300 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3800 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.2945 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3240 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3461 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |               |                  |                              |                   |               |               |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------|------------------------------|-------------------|---------------|---------------|---------|---------|---------|--------------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |              |
| TER Opening Type (Uw = 1.40)                                        |             |                | 14.4000       | 1.3258           | 19.0909                      |                   |               | (27)          |         |         |         |              |
| External Wall 1                                                     | 30.3761     | 14.4000        | 15.9761       | 0.1800           | 2.8757                       |                   |               | (29a)         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 30.3761       |                  |                              |                   |               | (31)          |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               |                  | (26)...(30) + (32) = 21.9666 |                   |               | (33)          |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                  |                              |                   |               | 250.0000 (35) |         |         |         |              |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |               |                  |                              |                   |               | 1.5188 (36)   |         |         |         |              |
| Total fabric heat loss                                              |             |                |               |                  |                              | (33) + (36) =     |               | 23.4854 (37)  |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                  |                              |                   |               |               |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 28.9600     | 28.8210        | 28.6848       | 28.0450          | 27.9253                      | 27.3680           | 27.3680       | 27.2648       | 27.5826 | 27.9253 | 28.1674 | 28.4206 (38) |
| Heat transfer coeff                                                 | 52.4454     | 52.3064        | 52.1702       | 51.5304          | 51.4107                      | 50.8534           | 50.8534       | 50.7502       | 51.0681 | 51.4107 | 51.6528 | 51.9060 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                  |                              |                   |               |               |         |         |         | 51.5298 (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.8524      | 0.8501         | 0.8479        | 0.8375           | 0.8355                       | 0.8265            | 0.8265        | 0.8248        | 0.8300  | 0.8355  | 0.8395  | 0.8436 (40)  |
| HLP (average)                                                       |             |                |               |                  |                              |                   |               |               |         |         |         | 0.8375 (40)  |
| Days in month                                                       | 31          | 28             | 31            | 30               | 31                           | 30                | 31            | 31            | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.0245 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 82.2830 (43)   |
| Daily hot water use                                         | 90.5113  | 87.2200  | 83.9286  | 80.6373  | 77.3460  | 74.0547 | 74.0547 | 77.3460 | 80.6373 | 83.9286            | 87.2200  | 90.5113 (44)   |
| Energy conte                                                | 134.2256 | 117.3946 | 121.1407 | 105.6134 | 101.3386 | 87.4475 | 81.0329 | 92.9865 | 94.0970 | 109.6610           | 119.7036 | 129.9903 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1294.6317 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 20.1338  | 17.6092  | 18.1711  | 15.8420  | 15.2008  | 13.1171 | 12.1549 | 13.9480 | 14.1146 | 16.4492            | 17.9555  | 19.4986 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852 (64) |
|                                                                 | 81.9059  | 72.7023  | 77.5552  | 71.1899  | 70.9710  | 65.1498  | 64.2194  | 68.1939  | 67.3607  | 73.7382  | 75.8749  | 80.4977 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.7608  | 13.9986  | 11.3844  | 8.6188   | 6.4426   | 5.4391   | 5.8772   | 7.6394   | 10.2536  | 13.0192  | 15.1954  | 16.1989  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 176.7885 | 178.6230 | 174.0001 | 164.1585 | 151.7352 | 140.0590 | 132.2587 | 130.4241 | 135.0471 | 144.8887 | 157.3120 | 168.9881 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | (71) |
| Water heating gains (Table 5)                                                       | 110.0886 | 108.1879 | 104.2409 | 98.8749  | 95.3911  | 90.4858  | 86.3164  | 91.6585  | 93.5566  | 99.1105  | 105.3818 | 108.1958 | (72) |
| Total internal gains                                                                | 359.0061 | 357.1777 | 345.9936 | 328.0203 | 309.9371 | 292.3521 | 280.8204 | 286.0902 | 295.2254 | 313.3866 | 334.2574 | 349.7510 | (73) |

#### 6. Solar gains

| [Jan]       |  |  |  |  | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |          |               |
|-------------|--|--|--|--|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|--------------|----------|----------|----------|---------------|
| -----       |  |  |  |  |            |                                |                                   |                                    |          |          |                              |              |          |          |          |               |
| Northeast   |  |  |  |  | 14.4000    | 11.2829                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 49.6543 (75) |          |          |          |               |
| -----       |  |  |  |  |            |                                |                                   |                                    |          |          |                              |              |          |          |          |               |
| Solar gains |  |  |  |  | 49.6543    | 101.0727                       | 182.1009                          | 299.0620                           | 401.9980 | 428.5724 | 400.9207                     | 319.6186     | 221.8928 | 123.5189 | 62.4779  | 40.5502 (83)  |
| Total gains |  |  |  |  | 408.6604   | 458.2504                       | 528.0945                          | 627.0823                           | 711.9351 | 720.9245 | 681.7411                     | 605.7088     | 517.1182 | 436.9055 | 396.7353 | 390.3012 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 81.4737 | 81.6901 | 81.9034 | 82.9203 | 83.1134 | 84.0242 | 84.0242 | 84.1951 | 83.6710 | 83.1134 | 82.7238 | 82.3203 |              |
| alpha                                                                       | 6.4316  | 6.4460  | 6.4602  | 6.5280  | 6.5409  | 6.6016  | 6.6016  | 6.6130  | 6.5781  | 6.5409  | 6.5149  | 6.4880  |              |
| util living area                                                            | 0.9960  | 0.9909  | 0.9682  | 0.8647  | 0.6544  | 0.4501  | 0.3281  | 0.3850  | 0.6630  | 0.9376  | 0.9905  | 0.9970  | (86)         |
| MIT                                                                         | 20.2434 | 20.3735 | 20.6040 | 20.8684 | 20.9802 | 20.9985 | 20.9998 | 20.9996 | 20.9846 | 20.7976 | 20.4742 | 20.2194 | (87)         |
| Th 2                                                                        | 20.2082 | 20.2101 | 20.2120 | 20.2210 | 20.2226 | 20.2304 | 20.2304 | 20.2319 | 20.2274 | 20.2226 | 20.2193 | 20.2157 | (88)         |
| util rest of house                                                          | 0.9948  | 0.9881  | 0.9589  | 0.8339  | 0.6053  | 0.3966  | 0.2708  | 0.3209  | 0.5961  | 0.9148  | 0.9871  | 0.9961  | (89)         |
| MIT 2                                                                       | 19.1971 | 19.3872 | 19.7176 | 20.0776 | 20.2055 | 20.2295 | 20.2304 | 20.2317 | 20.2164 | 19.9973 | 19.5415 | 19.1679 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         | (91)         |
| MIT                                                                         | 19.8972 | 20.0471 | 20.3107 | 20.6067 | 20.7239 | 20.7440 | 20.7452 | 20.7455 | 20.7304 | 20.5327 | 20.1656 | 19.8714 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |         | (93)         |
| adjusted MIT                                                                | 19.8972 | 20.0471 | 20.3107 | 20.6067 | 20.7239 | 20.7440 | 20.7452 | 20.7455 | 20.7304 | 20.5327 | 20.1656 | 19.8714 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9942   | 0.9874   | 0.9602   | 0.8498   | 0.6373   | 0.4324   | 0.3091   | 0.3638   | 0.6403   | 0.9247   | 0.9868   | 0.9955    | (94)  |
| Ext temp.            | 406.2902 | 452.4867 | 507.0721 | 532.8826 | 453.7030 | 311.7343 | 210.7364 | 220.3588 | 331.0853 | 404.0103 | 391.5053 | 388.5628  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 818.0005 | 792.2902 | 720.5073 | 603.2531 | 463.9228 | 312.4449 | 210.7992 | 220.5347 | 338.6010 | 510.6489 | 674.8732 | 813.4420  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 306.3124 | 228.3480 | 158.7958 | 50.6668  | 7.6036   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.3391  | 204.0249 | 316.1101  | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1351.2007 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 21.9600   | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |                                                                                                             |                 |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000                                                                                                      | (201)           |
| Fraction of space heat from main system(s)                            | 1.0000                                                                                                      | (202)           |
| Efficiency of main space heating system 1 (in %)                      | 93.5000                                                                                                     | (206)           |
| Efficiency of secondary/supplementary heating system, %               | 0.0000                                                                                                      | (208)           |
| Space heating requirement                                             | 1445.1344                                                                                                   | (211)           |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec                       |                                                                                                             |                 |
| Space heating requirement                                             | 306.3124 228.3480 158.7958 50.6668 7.6036 0.0000 0.0000 0.0000 0.0000 79.3391 204.0249 316.1101             | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000 93.5000 93.5000 93.5000 93.5000 0.0000 0.0000 0.0000 0.0000 93.5000 93.5000 93.5000                 | (210)           |
| Space heating fuel (main heating system)                              | 327.6069 244.2224 169.8351 54.1891 8.1321 0.0000 0.0000 0.0000 0.0000 84.8547 218.2084 338.0856             | (211)           |
| Water heating requirement                                             | 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000                         | (215)           |
| Water heating                                                         |                                                                                                             |                 |
| Water heating requirement                                             | 180.8205 159.4803 167.7356 150.7052 147.9335 132.5393 127.6278 139.5814 139.1889 156.2559 164.7954 176.5852 | (64)            |
| Efficiency of water heater                                            | 86.2092 85.7708 84.6682 82.2467 80.2639 79.8000 79.8000 79.8000 79.8000 83.1091 85.3845 86.3503             | (216)           |
| Fuel for water heating, kWh/month                                     | 209.7461 185.9378 198.1093 183.2356 184.3088 166.0894 159.9346 174.9140 174.4222 188.0131 193.0040 204.4988 | (219)           |
| Water heating fuel used                                               |                                                                                                             | 2222.2136 (219) |
| Annual totals kWh/year                                                |                                                                                                             |                 |
| Space heating fuel - main system                                      |                                                                                                             | 1445.1344 (211) |
| Space heating fuel - secondary                                        |                                                                                                             | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |                                                                                                             |                 |
| central heating pump                                                  |                                                                                                             | 30.0000 (230c)  |
| main heating flue fan                                                 |                                                                                                             | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |                                                                                                             | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |                                                                                                             | 278.3410 (232)  |
| Total delivered energy for all uses                                   |                                                                                                             | 4020.6891 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1445.1344          | 0.2160                        | 312.1490 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2222.2136          | 0.2160                        | 479.9981 (264)           |
| Space and water heating                                                                           |                    |                               | 792.1472 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 278.3410           | 0.5190                        | 144.4590 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 975.5312 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.8742 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3478 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6326 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.8742 * 1.00) + 2.3478 + 0.6326, rounded to 2 d.p. |                    |                               | 15.8500 (273)            |



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## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001030                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.09_1B |                |            |
| Property                           | B_2_13.09_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.43        | TER            | 15.85      |
| Environmental                      | 90 B                                | % DER<TER     | 8.99         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.78                                | DFEE          | 33.87        | TFEE           | 34.82      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 2.72         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.85 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.43 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)34.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)33.9 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.20 (max. 0.30) | 0.20 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.5300 (1b)              | x 2.5000 (2b)                   | = 153.8250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.5300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 153.8250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2   | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|---------------|----------------|------------------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |               |                | 14.4000                | 1.3258           | 19.0909      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 30.3761       | 14.4000        | 15.9761                | 0.2000           | 3.1952       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |               |                | 30.3761                |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |               |                | (26) ... (30) + (32) = |                  | 22.2861      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |               |                | 61.5300                |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |               |                | 61.4400                |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |               |                |                        |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |               |                |                        |                  |              |                   | 4.5564 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              | (33) + (36) = |                |                        |                  |              |                   | 26.8425 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |               |                |                        |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan           | Feb            | Mar                    | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 13.2727       | 13.1252        | 12.9777                | 12.2400          | 12.0925      | 11.3549           | 11.3549       | 11.2074 | 11.6499 | 12.0925 | 12.3876 | 12.6826 (38) |
| Heat transfer coeff                                                 | 40.1153       | 39.9678        | 39.8202                | 39.0826          | 38.9351      | 38.1974           | 38.1974       | 38.0499 | 38.4925 | 38.9351 | 39.2301 | 39.5252 (39) |
| Average = Sum(39)m / 12 =                                           |               |                |                        |                  |              |                   |               |         |         |         |         | 39.0457 (39) |
|                                                                     | Jan           | Feb            | Mar                    | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.6520        | 0.6496         | 0.6472                 | 0.6352           | 0.6328       | 0.6208            | 0.6208        | 0.6184  | 0.6256  | 0.6328  | 0.6376  | 0.6424 (40)  |
| HLP (average)                                                       |               |                |                        |                  |              |                   |               |         |         |         |         | 0.6346 (40)  |
| Days in month                                                       | 31            | 28             | 31                     | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |         |         |          |          | 2.0245 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |         |         |          |          | 82.2830 (43)                      |
| Daily hot water use                      | 90.5113  | 87.2200  | 83.9286  | 80.6373  | 77.3460  | 74.0547 | 74.0547 | 77.3460 | 80.6373 | 83.9286  | 87.2200  | 90.5113 (44)                      |
| Energy conte                             | 134.2256 | 117.3946 | 121.1407 | 105.6134 | 101.3386 | 87.4475 | 81.0329 | 92.9865 | 94.0970 | 109.6610 | 119.7036 | 129.9903 (45)                     |
| Energy content (annual)                  |          |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1294.6317 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |         |         |         |         |          |          | 19.4986 (46)                      |
| Water storage loss:                      | 20.1338  | 17.6092  | 18.1711  | 15.8420  | 15.2008  | 13.1171 | 12.1549 | 13.9480 | 14.1146 | 16.4492  | 17.9555  | 19.4986 (46)                      |
| Store volume                             |          |          |          |          |          |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |               |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)   |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |
| Primary loss                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 189.5024 | 167.3220 | 176.4175 | 159.1071 | 156.6154 | 140.9412 | 136.3097 | 148.2633 | 147.5907 | 164.9378 | 173.1973 | 185.2671 (62) |
| Solar input                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Solar input (sum of months) = Sum(63)m = 0.0000 (63)            |          |          |          |          |          |          |          |          |          |          |          |               |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 189.5024 | 167.3220 | 176.4175 | 159.1071 | 156.6154 | 140.9412 | 136.3097 | 148.2633 | 147.5907 | 164.9378 | 173.1973 | 185.2671 (64) |
| Total per year (kWh/year) = Sum(64)m = 1945.4715 (64)           |          |          |          |          |          |          |          |          |          |          |          |               |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 88.8515  | 78.9756  | 84.5007  | 77.9114  | 77.9165  | 71.8712  | 71.1649  | 75.1394  | 74.0822  | 80.6837  | 82.5964  | 87.4432 (65)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 889.5704  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 934.0489  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1945.4715 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2042.7451 | (310a) |
| Electricity used for heat distribution                                                  | 29.7679   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 98.5249   | (330a) |
| Total electricity for the above, kWh/year                                               | 98.5249   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 278.3410  | (332)  |
| Total delivered energy for all uses                                                     | 3353.6599 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3133.4674          | 0.2160                        | 676.8289 (367)           |
| Electrical energy for heat distribution                                                    | 29.7679            | 0.5190                        | 15.4496 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 692.2785 (373)           |
| Space and water heating                                                                    |                    |                               | 692.2785 (376)           |
| Pumps and fans                                                                             | 98.5249            | 0.5190                        | 51.1344 (378)            |
| Energy for lighting                                                                        | 278.3410           | 0.5190                        | 144.4590 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 887.8719 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.4300 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 14.4300 | ZC1 |
| Total Floor Area                                                                | TFA | 61.5300 |     |
| Assumed number of occupants                                                     | N   | 2.0245  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.0260 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.7237  | ZC3 |
| Total CO2 emissions                                                             |     | 34.1797 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 34.1797 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.5300 (1b)              | x 2.5000 (2b)                   | = 153.8250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.5300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 153.8250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1300 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3800 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.2945 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3240 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3461 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |               |                  |                      |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------|----------------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K         | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 14.4000       | 1.3258           | 19.0909              |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 30.3761     | 14.4000        | 15.9761       | 0.1800           | 2.8757               |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 30.3761       |                  |                      |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               |                  | (26)...(30) + (32) = | 21.9666           |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                  |                      |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |               |                  |                      |                   |               | 1.5188 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |               |                  |                      | (33) + (36) =     | 23.4854       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                  |                      |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                  | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 28.9600     | 28.8210        | 28.6848       | 28.0450          | 27.9253              | 27.3680           | 27.3680       | 27.2648       | 27.5826 | 27.9253 | 28.1674 | 28.4206 | (38) |
| Heat transfer coeff                                                 | 52.4454     | 52.3064        | 52.1702       | 51.5304          | 51.4107              | 50.8534           | 50.8534       | 50.7502       | 51.0681 | 51.4107 | 51.6528 | 51.9060 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                  |                      |                   |               |               |         |         |         | 51.5298 | (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                  | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.8524      | 0.8501         | 0.8479        | 0.8375           | 0.8355               | 0.8265            | 0.8265        | 0.8248        | 0.8300  | 0.8355  | 0.8395  | 0.8436  | (40) |
| HLP (average)                                                       |             |                |               |                  |                      |                   |               |               |         |         |         | 0.8375  | (40) |
| Days in month                                                       | 31          | 28             | 31            | 30               | 31                   | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.0245 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 82.2830 (43)   |
| Daily hot water use                                         | 90.5113  | 87.2200  | 83.9286  | 80.6373  | 77.3460  | 74.0547 | 74.0547 | 77.3460 | 80.6373 | 83.9286            | 87.2200  | 90.5113 (44)   |
| Energy conte                                                | 134.2256 | 117.3946 | 121.1407 | 105.6134 | 101.3386 | 87.4475 | 81.0329 | 92.9865 | 94.0970 | 109.6610           | 119.7036 | 129.9903 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1294.6317 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 20.1338  | 17.6092  | 18.1711  | 15.8420  | 15.2008  | 13.1171 | 12.1549 | 13.9480 | 14.1146 | 16.4492            | 17.9555  | 19.4986 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852 (64) |
|                                                                 | 81.9059  | 72.7023  | 77.5552  | 71.1899  | 70.9710  | 65.1498  | 64.2194  | 68.1939  | 67.3607  | 73.7382  | 75.8749  | 80.4977 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.7608  | 13.9986  | 11.3844  | 8.6188   | 6.4426   | 5.4391   | 5.8772   | 7.6394   | 10.2536  | 13.0192  | 15.1954  | 16.1989  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 176.7885 | 178.6230 | 174.0001 | 164.1585 | 151.7352 | 140.0590 | 132.2587 | 130.4241 | 135.0471 | 144.8887 | 157.3120 | 168.9881 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | (71) |
| Water heating gains (Table 5)                                                       | 110.0886 | 108.1879 | 104.2409 | 98.8749  | 95.3911  | 90.4858  | 86.3164  | 91.6585  | 93.5566  | 99.1105  | 105.3818 | 108.1958 | (72) |
| Total internal gains                                                                | 359.0061 | 357.1777 | 345.9936 | 328.0203 | 309.9371 | 292.3521 | 280.8204 | 286.0902 | 295.2254 | 313.3866 | 334.2574 | 349.7510 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |  |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|--|
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |  |
| Northeast   |          |          |          |          | 14.4000    | 11.2829                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 49.6543 (75)  |  |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |  |
| Solar gains | 49.6543  | 101.0727 | 182.1009 | 299.0620 | 401.9980   | 428.5724                       | 400.9207                          | 319.6186                           | 221.8928 | 123.5189 | 62.4779                      | 40.5502 (83)  |  |
| Total gains | 408.6604 | 458.2504 | 528.0945 | 627.0823 | 711.9351   | 720.9245                       | 681.7411                          | 605.7088                           | 517.1182 | 436.9055 | 396.7353                     | 390.3012 (84) |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 81.4737 | 81.6901 | 81.9034 | 82.9203 | 83.1134 | 84.0242 | 84.0242 | 84.1951 | 83.6710 | 83.1134 | 82.7238 | 82.3203 |              |
| alpha                                                                       | 6.4316  | 6.4460  | 6.4602  | 6.5280  | 6.5409  | 6.6016  | 6.6016  | 6.6130  | 6.5781  | 6.5409  | 6.5149  | 6.4880  |              |
| util living area                                                            | 0.9960  | 0.9909  | 0.9682  | 0.8647  | 0.6544  | 0.4501  | 0.3281  | 0.3850  | 0.6630  | 0.9376  | 0.9905  | 0.9970  | (86)         |
| MIT                                                                         | 20.2434 | 20.3735 | 20.6040 | 20.8684 | 20.9802 | 20.9985 | 20.9998 | 20.9996 | 20.9846 | 20.7976 | 20.4742 | 20.2194 | (87)         |
| Th 2                                                                        | 20.2082 | 20.2101 | 20.2120 | 20.2210 | 20.2226 | 20.2304 | 20.2304 | 20.2319 | 20.2274 | 20.2226 | 20.2193 | 20.2157 | (88)         |
| util rest of house                                                          | 0.9948  | 0.9881  | 0.9589  | 0.8339  | 0.6053  | 0.3966  | 0.2708  | 0.3209  | 0.5961  | 0.9148  | 0.9871  | 0.9961  | (89)         |
| MIT 2                                                                       | 19.1971 | 19.3872 | 19.7176 | 20.0776 | 20.2055 | 20.2295 | 20.2304 | 20.2317 | 20.2164 | 19.9973 | 19.5415 | 19.1679 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         | (91)         |
| MIT                                                                         | 19.8972 | 20.0471 | 20.3107 | 20.6067 | 20.7239 | 20.7440 | 20.7452 | 20.7455 | 20.7304 | 20.5327 | 20.1656 | 19.8714 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.8972 | 20.0471 | 20.3107 | 20.6067 | 20.7239 | 20.7440 | 20.7452 | 20.7455 | 20.7304 | 20.5327 | 20.1656 | 19.8714 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9942   | 0.9874   | 0.9602   | 0.8498   | 0.6373   | 0.4324   | 0.3091   | 0.3638   | 0.6403   | 0.9247   | 0.9868   | 0.9955    | (94)  |
| Ext temp.            | 406.2902 | 452.4867 | 507.0721 | 532.8826 | 453.7030 | 311.7343 | 210.7364 | 220.3588 | 331.0853 | 404.0103 | 391.5053 | 388.5628  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 818.0005 | 792.2902 | 720.5073 | 603.2531 | 463.9228 | 312.4449 | 210.7992 | 220.5347 | 338.6010 | 510.6489 | 674.8732 | 813.4420  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 306.3124 | 228.3480 | 158.7958 | 50.6668  | 7.6036   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.3391  | 204.0249 | 316.1101  | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1351.2007 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 21.9600   | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1445.1344 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 306.3124 | 228.3480 | 158.7958 | 50.6668  | 7.6036   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.3391  | 204.0249 | 316.1101  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 327.6069 | 244.2224 | 169.8351 | 54.1891  | 8.1321   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.8547  | 218.2084 | 338.0856  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Water heating requirement                                             | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852  | (64)            |
| Efficiency of water heater                                            | 86.2092  | 85.7708  | 84.6682  | 82.2467  | 80.2639  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.1091  | 85.3845  | 86.3503   | (216)           |
| (217)m                                                                | 86.2092  | 85.7708  | 84.6682  | 82.2467  | 80.2639  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.1091  | 85.3845  | 86.3503   | (217)           |
| Fuel for water heating, kWh/month                                     | 209.7461 | 185.9378 | 198.1093 | 183.2356 | 184.3088 | 166.0894 | 159.9346 | 174.9140 | 174.4222 | 188.0131 | 193.0040 | 204.4988  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2222.2136 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1445.1344 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 278.3410  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4020.6891 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1445.1344          | 0.2160                        | 312.1490 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2222.2136          | 0.2160                        | 479.9981 (264)           |
| Space and water heating                                                                           |                    |                               | 792.1472 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 278.3410           | 0.5190                        | 144.4590 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 975.5312 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.8742 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3478 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6326 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.8742 * 1.00) + 2.3478 + 0.6326, rounded to 2 d.p. |                    |                               | 15.8500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001058                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.09_1B |                |            |
| Property                           | B_2_13.09_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.93        | TER            | 15.85      |
| Environmental                      | 91 B                                | % DER<TER     | 18.45        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.72                                | DFEE          | 27.48        | TFEE           | 34.82      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 21.08        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.85 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.93 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)34.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)27.5 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.5300 (1b)              | x 2.5000 (2b)                   | = 153.8250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.5300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 153.8250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K              |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|----------------------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |             |                | 14.4000              | 0.9615           | 13.8462      |                   | (27)                       |         |         |         |         |              |
| External Wall 1                                                     | 30.3761     | 14.4000        | 15.9761              | 0.1600           | 2.5562       |                   | (29a)                      |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 30.3761              |                  |              |                   | (31)                       |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 16.4023      |                   | (33)                       |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 61.5300              |                  |              |                   | (32d)                      |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 61.4400              |                  |              |                   | (32b)                      |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   | 100.0000 (35)              |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 4.5564 (36)                |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   | (33) + (36) = 20.9587 (37) |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 13.2727     | 13.1252        | 12.9777              | 12.2400          | 12.0925      | 11.3549           | 11.3549                    | 11.2074 | 11.6499 | 12.0925 | 12.3876 | 12.6826 (38) |
| Heat transfer coeff                                                 | 34.2315     | 34.0840        | 33.9364              | 33.1988          | 33.0513      | 32.3136           | 32.3136                    | 32.1661 | 32.6087 | 33.0513 | 33.3463 | 33.6414 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |                            |         |         |         |         | 33.1619 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.5563      | 0.5539         | 0.5515               | 0.5396           | 0.5372       | 0.5252            | 0.5252                     | 0.5228  | 0.5300  | 0.5372  | 0.5420  | 0.5467 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |                            |         |         |         |         | 0.5390 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31                         | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |         |         |          |          | 2.0245 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |         |         |          |          | 82.2830 (43)                      |
| Daily hot water use                      | 90.5113  | 87.2200  | 83.9286  | 80.6373  | 77.3460  | 74.0547 | 74.0547 | 77.3460 | 80.6373 | 83.9286  | 87.2200  | 90.5113 (44)                      |
| Energy conte                             | 134.2256 | 117.3946 | 121.1407 | 105.6134 | 101.3386 | 87.4475 | 81.0329 | 92.9865 | 94.0970 | 109.6610 | 119.7036 | 129.9903 (45)                     |
| Energy content (annual)                  |          |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1294.6317 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |         |         |         |         |          |          | 19.4986 (46)                      |
| Water storage loss:                      | 20.1338  | 17.6092  | 18.1711  | 15.8420  | 15.2008  | 13.1171 | 12.1549 | 13.9480 | 14.1146 | 16.4492  | 17.9555  | 19.4986 (46)                      |
| Store volume                             |          |          |          |          |          |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |              |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|--------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |               |              |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          |               | 0.0152 (51)  |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          |               | 1.0294 (52)  |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          |               | 0.6000 (53)  |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          |               | 1.0327 (55)  |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |              |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144       | 32.0144 (56) |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |              |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |              |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (58)  |              |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |              |
|                                                                 | 189.5024 | 167.3220 | 176.4175 | 159.1071 | 156.6154 | 140.9412 | 136.3097 | 148.2633 | 147.5907 | 164.9378 | 173.1973 | 185.2671 (59) |              |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |              |
| Solar input (sum of months) = Sum (63)m = 0.0000 (63)           |          |          |          |          |          |          |          |          |          |          |          |               |              |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |              |
|                                                                 | 189.5024 | 167.3220 | 176.4175 | 159.1071 | 156.6154 | 140.9412 | 136.3097 | 148.2633 | 147.5907 | 164.9378 | 173.1973 | 185.2671 (64) |              |
| Total per year (kWh/year) = Sum (64)m = 1945.4715 (64)          |          |          |          |          |          |          |          |          |          |          |          |               |              |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |              |
|                                                                 | 88.8515  | 78.9756  | 84.5007  | 77.9114  | 77.9165  | 71.8712  | 71.1649  | 75.1394  | 74.0822  | 80.6837  | 82.5964  | 87.4432 (65)  |              |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 510.4923  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 536.0169  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1945.4715 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2042.7451 | (310a) |
| Electricity used for heat distribution                                                  | 25.7876   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 98.5249   | (330a) |
| Total electricity for the above, kWh/year                                               | 98.5249   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 278.3410  | (332)  |
| Total delivered energy for all uses                                                     | 2955.6279 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2714.4862          | 0.2160                        | 586.3290 (367)           |
| Electrical energy for heat distribution                                                    | 25.7876            | 0.5190                        | 13.3838 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 599.7128 (373)           |
| Space and water heating                                                                    |                    |                               | 599.7128 (376)           |
| Pumps and fans                                                                             | 98.5249            | 0.5190                        | 51.1344 (378)            |
| Energy for lighting                                                                        | 278.3410           | 0.5190                        | 144.4590 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 795.3062 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.9300 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 12.9300 | ZC1 |
| Total Floor Area                                                                | TFA | 61.5300 |     |
| Assumed number of occupants                                                     | N   | 2.0245  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.0260 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.7237  | ZC3 |
| Total CO2 emissions                                                             |     | 32.6797 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 32.6797 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.5300 (1b)              | x 2.5000 (2b)                   | = 153.8250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.5300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 153.8250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1300 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3800 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.2945 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3240 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3461 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |               |                  |                              |                   |               |               |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------|------------------------------|-------------------|---------------|---------------|---------|---------|---------|--------------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |              |
| TER Opening Type (Uw = 1.40)                                        |             |                | 14.4000       | 1.3258           | 19.0909                      |                   |               | (27)          |         |         |         |              |
| External Wall 1                                                     | 30.3761     | 14.4000        | 15.9761       | 0.1800           | 2.8757                       |                   |               | (29a)         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 30.3761       |                  |                              |                   |               | (31)          |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               |                  | (26)...(30) + (32) = 21.9666 |                   |               | (33)          |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                  |                              |                   |               | 250.0000 (35) |         |         |         |              |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |               |                  |                              |                   |               | 1.5188 (36)   |         |         |         |              |
| Total fabric heat loss                                              |             |                |               |                  |                              | (33) + (36) =     |               | 23.4854 (37)  |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                  |                              |                   |               |               |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 28.9600     | 28.8210        | 28.6848       | 28.0450          | 27.9253                      | 27.3680           | 27.3680       | 27.2648       | 27.5826 | 27.9253 | 28.1674 | 28.4206 (38) |
| Heat transfer coeff                                                 | 52.4454     | 52.3064        | 52.1702       | 51.5304          | 51.4107                      | 50.8534           | 50.8534       | 50.7502       | 51.0681 | 51.4107 | 51.6528 | 51.9060 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                  |                              |                   |               |               |         |         |         | 51.5298 (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May                          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.8524      | 0.8501         | 0.8479        | 0.8375           | 0.8355                       | 0.8265            | 0.8265        | 0.8248        | 0.8300  | 0.8355  | 0.8395  | 0.8436 (40)  |
| HLP (average)                                                       |             |                |               |                  |                              |                   |               |               |         |         |         | 0.8375 (40)  |
| Days in month                                                       | 31          | 28             | 31            | 30               | 31                           | 30                | 31            | 31            | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.0245 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 82.2830 (43)   |
| Daily hot water use                                         | 90.5113  | 87.2200  | 83.9286  | 80.6373  | 77.3460  | 74.0547 | 74.0547 | 77.3460 | 80.6373 | 83.9286            | 87.2200  | 90.5113 (44)   |
| Energy conte                                                | 134.2256 | 117.3946 | 121.1407 | 105.6134 | 101.3386 | 87.4475 | 81.0329 | 92.9865 | 94.0970 | 109.6610           | 119.7036 | 129.9903 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1294.6317 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 20.1338  | 17.6092  | 18.1711  | 15.8420  | 15.2008  | 13.1171 | 12.1549 | 13.9480 | 14.1146 | 16.4492            | 17.9555  | 19.4986 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852 (64) |
|                                                                 | 81.9059  | 72.7023  | 77.5552  | 71.1899  | 70.9710  | 65.1498  | 64.2194  | 68.1939  | 67.3607  | 73.7382  | 75.8749  | 80.4977 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 | 101.2273 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.7608  | 13.9986  | 11.3844  | 8.6188   | 6.4426   | 5.4391   | 5.8772   | 7.6394   | 10.2536  | 13.0192  | 15.1954  | 16.1989 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 176.7885 | 178.6230 | 174.0001 | 164.1585 | 151.7352 | 140.0590 | 132.2587 | 130.4241 | 135.0471 | 144.8887 | 157.3120 | 168.9881 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227  | 33.1227 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 | -80.9819 (71) |
| Water heating gains (Table 5)                                                       | 110.0886 | 108.1879 | 104.2409 | 98.8749  | 95.3911  | 90.4858  | 86.3164  | 91.6585  | 93.5566  | 99.1105  | 105.3818 | 108.1958 (72) |
| Total internal gains                                                                | 359.0061 | 357.1777 | 345.9936 | 328.0203 | 309.9371 | 292.3521 | 280.8204 | 286.0902 | 295.2254 | 313.3866 | 334.2574 | 349.7510 (73) |

#### 6. Solar gains

|             |          |            |               |               |          |              |
|-------------|----------|------------|---------------|---------------|----------|--------------|
| [Jan]       | Area     | Solar flux | g             | FF            | Access   | Gains        |
|             | m2       | Table 6a   | Specific data | Specific data | factor   | W            |
|             |          | W/m2       | or Table 6b   | or Table 6c   | Table 6d |              |
| Northeast   | 14.4000  | 11.2829    | 0.6300        | 0.7000        | 0.7700   | 49.6543 (75) |
| Solar gains | 49.6543  | 101.0727   | 182.1009      | 299.0620      | 401.9980 | 428.5724     |
| Total gains | 408.6604 | 458.2504   | 528.0945      | 627.0823      | 711.9351 | 720.9245     |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |                                       |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|---------------------------------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |              | 21.0000 (85)                          |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |                                       |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |                                       |
| tau                                                                         | 81.4737 | 81.6901 | 81.9034 | 82.9203 | 83.1134 | 84.0242 | 84.0242 | 84.1951 | 83.6710 | 83.1134 | 82.7238 | 82.3203      |                                       |
| alpha                                                                       | 6.4316  | 6.4460  | 6.4602  | 6.5280  | 6.5409  | 6.6016  | 6.6016  | 6.6130  | 6.5781  | 6.5409  | 6.5149  | 6.4880       |                                       |
| util living area                                                            | 0.9960  | 0.9909  | 0.9682  | 0.8647  | 0.6544  | 0.4501  | 0.3281  | 0.3850  | 0.6630  | 0.9376  | 0.9905  | 0.9970 (86)  |                                       |
| MIT                                                                         | 20.2434 | 20.3735 | 20.6040 | 20.8684 | 20.9802 | 20.9985 | 20.9998 | 20.9996 | 20.9846 | 20.7976 | 20.4742 | 20.2194 (87) |                                       |
| Th 2                                                                        | 20.2082 | 20.2101 | 20.2120 | 20.2210 | 20.2226 | 20.2304 | 20.2304 | 20.2319 | 20.2274 | 20.2226 | 20.2193 | 20.2157 (88) |                                       |
| util rest of house                                                          | 0.9948  | 0.9881  | 0.9589  | 0.8339  | 0.6053  | 0.3966  | 0.2708  | 0.3209  | 0.5961  | 0.9148  | 0.9871  | 0.9961 (89)  |                                       |
| MIT 2                                                                       | 19.1971 | 19.3872 | 19.7176 | 20.0776 | 20.2055 | 20.2295 | 20.2304 | 20.2317 | 20.2164 | 19.9973 | 19.5415 | 19.1679 (90) |                                       |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              | fLA = Living area / (4) = 0.6691 (91) |
| MIT                                                                         | 19.8972 | 20.0471 | 20.3107 | 20.6067 | 20.7239 | 20.7440 | 20.7452 | 20.7455 | 20.7304 | 20.5327 | 20.1656 | 19.8714 (92) |                                       |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |              | 0.0000                                |
| adjusted MIT                                                                | 19.8972 | 20.0471 | 20.3107 | 20.6067 | 20.7239 | 20.7440 | 20.7452 | 20.7455 | 20.7304 | 20.5327 | 20.1656 | 19.8714 (93) |                                       |

#### 8. Space heating requirement

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9942   | 0.9874   | 0.9602   | 0.8498   | 0.6373   | 0.4324   | 0.3091   | 0.3638   | 0.6403   | 0.9247       | 0.9868   | 0.9955 (94)    |
| Useful gains         | 406.2902 | 452.4867 | 507.0721 | 532.8826 | 453.7030 | 311.7343 | 210.7364 | 220.3588 | 331.0853 | 404.0103     | 391.5053 | 388.5628 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 818.0005 | 792.2902 | 720.5073 | 603.2531 | 463.9228 | 312.4449 | 210.7992 | 220.5347 | 338.6010 | 510.6489     | 674.8732 | 813.4420 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |              |          |                |
|                      | 306.3124 | 228.3480 | 158.7958 | 50.6668  | 7.6036   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.3391      | 204.0249 | 316.1101 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1351.2007 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 21.9600 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1445.1344 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 306.3124 | 228.3480 | 158.7958 | 50.6668  | 7.6036   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.3391  | 204.0249 | 316.1101  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 327.6069 | 244.2224 | 169.8351 | 54.1891  | 8.1321   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.8547  | 218.2084 | 338.0856  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Water heating requirement                                             | 180.8205 | 159.4803 | 167.7356 | 150.7052 | 147.9335 | 132.5393 | 127.6278 | 139.5814 | 139.1889 | 156.2559 | 164.7954 | 176.5852  | (64)            |
| Efficiency of water heater                                            | 86.2092  | 85.7708  | 84.6682  | 82.2467  | 80.2639  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.1091  | 85.3845  | 86.3503   | (216)           |
| (217)m                                                                | 86.2092  | 85.7708  | 84.6682  | 82.2467  | 80.2639  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.1091  | 85.3845  | 86.3503   | (217)           |
| Fuel for water heating, kWh/month                                     | 209.7461 | 185.9378 | 198.1093 | 183.2356 | 184.3088 | 166.0894 | 159.9346 | 174.9140 | 174.4222 | 188.0131 | 193.0040 | 204.4988  | (219)           |
| Water heating fuel used                                               | 209.7461 | 185.9378 | 198.1093 | 183.2356 | 184.3088 | 166.0894 | 159.9346 | 174.9140 | 174.4222 | 188.0131 | 193.0040 | 2222.2136 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1445.1344 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 278.3410  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4020.6891 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1445.1344          | 0.2160                        | 312.1490 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2222.2136          | 0.2160                        | 479.9981 (264)           |
| Space and water heating                                                                           |                    |                               | 792.1472 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 278.3410           | 0.5190                        | 144.4590 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 975.5312 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.8742 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3478 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6326 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.8742 * 1.00) + 2.3478 + 0.6326, rounded to 2 d.p. |                    |                               | 15.8500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001086                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.10_2B |                |            |
| Property                           | B_2_13.10_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 12.19        | TER            | 13.65      |
| Environmental                      | 90 B                                | % DER<TER     | 10.67        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.97                                | DFEE          | 32.14        | TFEE           | 34.26      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 6.19         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 92 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 13.65 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 12.19 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)34.3 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)32.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 21.60 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 92.4500 (1b)              | x 2.5000 (2b)                   | = 231.1250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 92.4500                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 231.1250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| Opening Type 1 (Uw = 1.40)                                          |                |                | 21.6000              | 1.3258           | 28.6364        |                   | (27)           |                |                |                |                |                |      |
| External Wall 1                                                     | 35.6308        | 21.6000        | 14.0308              | 0.1600           | 2.2449         |                   | (29a)          |                |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 35.6308              |                  |                |                   | (31)           |                |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 30.8813        |                   | (33)           |                |                |                |                |                |      |
| Party Floor 1                                                       |                |                | 92.4500              |                  |                |                   | (32d)          |                |                |                |                |                |      |
| Party Ceilings 1                                                    |                |                | 92.4500              |                  |                |                   | (32b)          |                |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   |                |                |                |                |                |                |      |
| Thermal bridges (Default value 0.150 * total exposed area)          |                |                |                      |                  |                |                   | 100.0000 (35)  |                |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                      |                  |                | (33) + (36) =     | 36.2259 (37)   |                |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>19.9425 | Feb<br>19.7209 | Mar<br>19.4992       | Apr<br>18.3909   | May<br>18.1692 | Jun<br>17.0609    | Jul<br>17.0609 | Aug<br>16.8393 | Sep<br>17.5043 | Oct<br>18.1692 | Nov<br>18.6126 | Dec<br>19.0559 | (38) |
| Heat transfer coeff                                                 | 56.1685        | 55.9468        | 55.7251              | 54.6168          | 54.3952        | 53.2868           | 53.2868        | 53.0652        | 53.7302        | 54.3952        | 54.8385        | 55.2818        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                |                   |                |                |                |                |                | 54.5614        | (39) |
| HLP                                                                 | Jan<br>0.6076  | Feb<br>0.6052  | Mar<br>0.6028        | Apr<br>0.5908    | May<br>0.5884  | Jun<br>0.5764     | Jul<br>0.5764  | Aug<br>0.5740  | Sep<br>0.5812  | Oct<br>0.5884  | Nov<br>0.5932  | Dec<br>0.5980  | (40) |
| HLP (average)                                                       |                |                |                      |                  |                |                   |                |                |                |                |                | 0.5902         | (40) |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |          |          |         |          |          |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |          |          |         |          |          |          |          | 2.6578 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |          |          | 97.3226 (43)                      |
| Daily hot water use                      | 107.0548 | 103.1619 | 99.2690  | 95.3761  | 91.4832  | 87.5903  | 87.5903 | 91.4832  | 95.3761  | 99.2690  | 103.1619 | 107.0548 (44)                     |
| Energy conte                             | 158.7592 | 138.8518 | 143.2826 | 124.9173 | 119.8611 | 103.4310 | 95.8440 | 109.9824 | 111.2960 | 129.7047 | 141.5828 | 153.7498 (45)                     |
| Energy content (annual)                  |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1531.2627 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |          |         |          |          |          |          |                                   |
|                                          | 23.8139  | 20.8278  | 21.4924  | 18.7376  | 17.9792  | 15.5147  | 14.3766 | 16.4974  | 16.6944  | 19.4557  | 21.2374  | 23.0625 (46)                      |
| Water storage loss:                      |          |          |          |          |          |          |         |          |          |          |          |                                   |
| Store volume                             |          |          |          |          |          |          |         |          |          |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (58)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 214.0360 | 188.7792 | 198.5594 | 178.4109 | 175.1379 | 156.9247 | 151.1208 | 165.2592                                 | 164.7896 | 184.9815 | 195.0765 | 209.0266 (59) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 | 214.0360 | 188.7792 | 198.5594 | 178.4109 | 175.1379 | 156.9247 | 151.1208 | 165.2592                                 | 164.7896 | 184.9815 | 195.0765 | 209.0266 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 2182.1025 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 97.0089  | 86.1102  | 91.8629  | 84.3299  | 84.0753  | 77.1858  | 76.0896  | 80.7906                                  | 79.8009  | 87.3483  | 89.8712  | 95.3432 (65)  |                |

| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.7094   | 19.2821   | 15.6813   | 11.8717   | 8.8743    | 7.4920    | 8.0954    | 10.5227   | 14.1235   | 17.9331   | 20.9305   | 22.3128 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 243.5136  | 246.0405  | 239.6727  | 226.1166  | 209.0044  | 192.9214  | 182.1769  | 179.6500  | 186.0177  | 199.5739  | 216.6861  | 232.7691 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 (71) |
| Water heating gains (Table 5)                                                       | 130.3883  | 128.1401  | 123.4717  | 117.1249  | 113.0044  | 107.2024  | 102.2709  | 108.5895  | 110.8345  | 117.4036  | 124.8212  | 128.1495 (72)  |
| Total internal gains                                                                | 458.4781  | 456.3296  | 441.6925  | 417.9801  | 393.7499  | 370.4827  | 355.4101  | 361.6291  | 373.8427  | 397.7774  | 425.3046  | 446.0983 (73)  |

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |               | Gains<br>W |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|---------------|------------|
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |               |            |
| Northeast   |          |          |          | 21.6000    | 11.2829                        | 0.3000                            |                                    | 0.8000   |          | 0.7700                       |          | 40.5341 (75)  |            |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |          |               |            |
| Solar gains | 40.5341  | 82.5083  | 148.6538 | 244.1322   | 328.1616                       | 349.8550                          | 327.2822                           | 260.9131 | 181.1370 | 100.8317                     | 51.0024  | 33.1022 (83)  |            |
| Total gains | 499.0122 | 538.8379 | 590.3463 | 662.1123   | 721.9115                       | 720.3377                          | 682.6923                           | 622.5422 | 554.9796 | 498.6091                     | 476.3070 | 479.2005 (84) |            |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 45.7206 | 45.9017 | 46.0843 | 47.0195 | 47.2111 | 48.1931 | 48.1931 | 48.3944 | 47.7954                   | 47.2111 | 46.8294 | 46.4539      |
| alpha                                                                       | 4.0480  | 4.0601  | 4.0723  | 4.1346  | 4.1474  | 4.2129  | 4.2129  | 4.2263  | 4.1864                    | 4.1474  | 4.1220  | 4.0969       |
| util living area                                                            | 0.9621  | 0.9461  | 0.9058  | 0.8045  | 0.6436  | 0.4625  | 0.3409  | 0.3875  | 0.6213                    | 0.8530  | 0.9407  | 0.9667 (86)  |
| MIT                                                                         | 19.9102 | 20.0687 | 20.3483 | 20.6927 | 20.9010 | 20.9811 | 20.9959 | 20.9931 | 20.9376                   | 20.6631 | 20.2476 | 19.8877 (87) |
| Th 2                                                                        | 20.4232 | 20.4254 | 20.4275 | 20.4383 | 20.4405 | 20.4513 | 20.4513 | 20.4535 | 20.4470                   | 20.4405 | 20.4362 | 20.4318 (88) |
| util rest of house                                                          | 0.9577  | 0.9400  | 0.8953  | 0.7849  | 0.6136  | 0.4255  | 0.2993  | 0.3430  | 0.5810                    | 0.8332  | 0.9330  | 0.9628 (89)  |
| MIT 2                                                                       | 18.9324 | 19.1620 | 19.5628 | 20.0503 | 20.3263 | 20.4327 | 20.4481 | 20.4479 | 20.3814                   | 20.0194 | 19.4299 | 18.9061 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3112 (91)  |
| MIT                                                                         | 19.2367 | 19.4442 | 19.8073 | 20.2502 | 20.5051 | 20.6034 | 20.6186 | 20.6175 | 20.5545                   | 20.2197 | 19.6843 | 19.2116 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.2367 | 19.4442 | 19.8073 | 20.2502 | 20.5051 | 20.6034 | 20.6186 | 20.6175 | 20.5545                   | 20.2197 | 19.6843 | 19.2116 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9467   | 0.9276   | 0.8825   | 0.7779   | 0.6171   | 0.4359   | 0.3120   | 0.3564   | 0.5890   | 0.8247       | 0.9210   | 0.9526 (94)    |
| Useful gains         | 472.3962 | 499.8501 | 520.9635 | 515.0296 | 445.5111 | 313.9946 | 213.0220 | 221.8959 | 326.8900 | 411.1852     | 438.6672 | 456.4706 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 838.9714 | 813.7005 | 741.5498 | 619.9122 | 478.9561 | 319.8999 | 214.1361 | 223.8045 | 346.7994 | 523.2645     | 690.1063 | 829.8668 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 272.7320 | 210.9075 | 164.1163 | 75.5155  | 24.8831  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 83.3870      | 181.0362 | 277.8068 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1290.3844 (99) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 13.9576 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 1290.3844 | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 1354.9036 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 2182.1025 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2291.2076 | (310a) |
| Electricity used for heat distribution                                                  | 36.4611   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |           |        |
| mechanical ventilation fans (SFP = 0.5500)                                              | 155.0849  | (330a) |
| Total electricity for the above, kWh/year                                               | 155.0849  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 383.3950  | (332)  |
| Total delivered energy for all uses                                                     | 4184.5911 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3838.0119          | 0.2160                        | 829.0106 (367)           |
| Electrical energy for heat distribution                                                    | 36.4611            | 0.5190                        | 18.9233 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 847.9339 (373)           |
| Space and water heating                                                                    |                    |                               | 847.9339 (376)           |
| Pumps and fans                                                                             | 155.0849           | 0.5190                        | 80.4891 (378)            |
| Energy for lighting                                                                        | 383.3950           | 0.5190                        | 198.9820 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1127.4049 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.1900 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 12.1900 | ZC1 |
| Total Floor Area                                                                | TFA | 92.4500 |     |
| Assumed number of occupants                                                     | N   | 2.6578  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 15.6085 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.9771  | ZC3 |
| Total CO2 emissions                                                             |     | 29.7757 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 29.7757 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 92.4500 (1b)              | x 2.5000 (2b)                   | = 231.1250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 92.4500                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 231.1250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 3 * 10 =        | 30.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             |                 | Air changes per hour    |
| Pressure test                                                             |                 |                      |                             | 30.0000 / (5) = | 0.1298 (8)              |
| Measured/design AP50                                                      |                 |                      |                             |                 | Yes                     |
| Infiltration rate                                                         |                 |                      |                             |                 | 5.0000                  |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0.3798 (18)             |
|                                                                           |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.2943 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3753 | 0.3679 | 0.3606 | 0.3238 | 0.3164 | 0.2796 | 0.2796 | 0.2723 | 0.2943 | 0.3164 | 0.3311 | 0.3459 (22b) |
|                 | 0.5704 | 0.5677 | 0.5650 | 0.5524 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5433 | 0.5501 | 0.5548 | 0.5598 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 21.6000                   | 1.3258                        | 28.6364      |                                | (27)          |
| External Wall 1                                                     | 35.6308                 | 21.6000                    | 14.0308                   | 0.1800                        | 2.5255       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 35.6308                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 31.1619      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.7815 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 32.9434 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 43.5067                 | 43.2982                    | 43.0937                   | 42.1335                       | 41.9538      | 41.1175                        | 41.1175       |
| Heat transfer coeff                                                 | 76.4502                 | 76.2416                    | 76.0372                   | 75.0769                       | 74.8973      | 74.0610                        | 74.0610       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              |                                |               |
| HLP                                                                 | 0.8269                  | 0.8247                     | 0.8225                    | 0.8121                        | 0.8101       | 0.8011                         | 0.8011        |
| HLP (average)                                                       |                         |                            |                           |                               |              |                                | 0.7994        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              |                                | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |          |         |          |          |          |            |           |               |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|------------|-----------|---------------|
| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |            |           | 2.6578 (42)   |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |            |           | 97.3226 (43)  |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov        | Dec       |               |
| Daily hot water use                                         |          |          |          |          |          |          |         |          |          |          |            |           |               |
|                                                             | 107.0548 | 103.1619 | 99.2690  | 95.3761  | 91.4832  | 87.5903  | 87.5903 | 91.4832  | 95.3761  | 99.2690  | 103.1619   | 107.0548  | (44)          |
| Energy conte                                                | 158.7592 | 138.8518 | 143.2826 | 124.9173 | 119.8611 | 103.4310 | 95.8440 | 109.9824 | 111.2960 | 129.7047 | 141.5828   | 153.7498  | (45)          |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          |            |           |               |
|                                                             |          |          |          |          |          |          |         |          |          | Total =  | Sum(45)m = | 1531.2627 | (45)          |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |          |         |          |          |          |            |           |               |
|                                                             | 23.8139  | 20.8278  | 21.4924  | 18.7376  | 17.9792  | 15.5147  | 14.3766 | 16.4974  | 16.6944  | 19.4557  | 21.2374    | 23.0625   | (46)          |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |            |           |               |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |            |           | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |            |           | 1.3938 (48)   |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |            |           | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |            |           | 0.7527 (55)   |
| Total storage loss                                          |          |          |          |          |          |          |         |          |          |          |            |           |               |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325  | 22.5798  | 23.3325  | 22.5798    | 23.3325   | (56)          |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |          |         |          |          |          |            |           |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 205.3541 | 180.9375 | 189.8775 | 170.0091 | 166.4560 | 148.5228 | 142.4389 | 156.5773                      | 156.3878    | 176.2996 | 186.6747 | 200.3447 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 205.3541 | 180.9375 | 189.8775 | 170.0091 | 166.4560 | 148.5228 | 142.4389 | 156.5773                      | 156.3878    | 176.2996 | 186.6747 | 200.3447 (64)  |
|                                                                 | 90.0634  | 79.8368  | 84.9174  | 77.6085  | 77.1297  | 70.4643  | 69.1441  | 73.8451                       | 73.0794     | 80.4027  | 83.1498  | 88.3977 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 2079.8801 (64) |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| (66)m                                                                               | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | 132.8896  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.7094   | 19.2821   | 15.6813   | 11.8717   | 8.8743    | 7.4920    | 8.0954    | 10.5227   | 14.1235   | 17.9331   | 20.9305   | 22.3128   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 243.5136  | 246.0405  | 239.6727  | 226.1166  | 209.0044  | 192.9214  | 182.1769  | 179.6500  | 186.0177  | 199.5739  | 216.6861  | 232.7691  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | 36.2890   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | -106.3117 | (71) |
| Water heating gains (Table 5)                                                       | 121.0529  | 118.8048  | 114.1363  | 107.7895  | 103.6690  | 97.8671   | 92.9356   | 99.2541   | 101.4991  | 108.0682  | 115.4858  | 118.8142  | (72) |
| Total internal gains                                                                | 452.1428  | 449.9942  | 435.3572  | 411.6447  | 387.4145  | 364.1473  | 349.0747  | 355.2937  | 367.5073  | 391.4420  | 418.9693  | 439.7629  | (73) |

#### 6. Solar gains

|             |          |            |               |               |          |               |
|-------------|----------|------------|---------------|---------------|----------|---------------|
| [Jan]       | Area     | Solar flux | g             | FF            | Access   | Gains         |
|             | m2       | Table 6a   | Specific data | Specific data | factor   | W             |
|             |          | W/m2       | or Table 6b   | or Table 6c   | Table 6d |               |
| Northeast   | 21.6000  | 11.2829    | 0.6300        | 0.7000        | 0.7700   | 74.4814 (75)  |
| Solar gains | 74.4814  | 151.6091   | 273.1513      | 448.5929      | 602.9969 | 642.8585      |
| Total gains | 526.6242 | 601.6033   | 708.5085      | 860.2377      | 990.4115 | 1007.0059     |
|             |          |            |               |               |          | 950.4557      |
|             |          |            |               |               |          | 834.7216      |
|             |          |            |               |               |          | 700.3464      |
|             |          |            |               |               |          | 576.7203      |
|             |          |            |               |               |          | 512.6862      |
|             |          |            |               |               |          | 500.5882 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 83.9781 | 84.2078 | 84.4342 | 85.5141 | 85.7192 | 86.6872 | 86.6872 | 86.8689 | 86.3118                   | 85.7192 | 85.3053 | 84.8768      |
| alpha                                                                       | 6.5985  | 6.6139  | 6.6289  | 6.7009  | 6.7146  | 6.7791  | 6.7791  | 6.7913  | 6.7541                    | 6.7146  | 6.6870  | 6.6585       |
| util living area                                                            | 0.9983  | 0.9954  | 0.9803  | 0.8926  | 0.6823  | 0.4692  | 0.3427  | 0.4067  | 0.7065                    | 0.9617  | 0.9957  | 0.9988 (86)  |
| MIT                                                                         | 20.1894 | 20.3212 | 20.5592 | 20.8478 | 20.9774 | 20.9983 | 20.9998 | 20.9995 | 20.9800                   | 20.7571 | 20.4204 | 20.1666 (87) |
| Th 2                                                                        | 20.2300 | 20.2320 | 20.2339 | 20.2429 | 20.2446 | 20.2524 | 20.2524 | 20.2538 | 20.2494                   | 20.2446 | 20.2412 | 20.2376 (88) |
| util rest of house                                                          | 0.9977  | 0.9940  | 0.9741  | 0.8657  | 0.6335  | 0.4151  | 0.2846  | 0.3411  | 0.6399                    | 0.9460  | 0.9940  | 0.9984 (89)  |
| MIT 2                                                                       | 19.1354 | 19.3290 | 19.6736 | 20.0734 | 20.2247 | 20.2514 | 20.2523 | 20.2536 | 20.2346                   | 19.9642 | 19.4814 | 19.1080 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3112 (91)  |
| MIT                                                                         | 19.4634 | 19.6377 | 19.9492 | 20.3144 | 20.4590 | 20.4838 | 20.4849 | 20.4857 | 20.4666                   | 20.2110 | 19.7736 | 19.4374 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.4634 | 19.6377 | 19.9492 | 20.3144 | 20.4590 | 20.4838 | 20.4849 | 20.4857 | 20.4666                   | 20.2110 | 19.7736 | 19.4374 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9970    | 0.9925    | 0.9713    | 0.8685   | 0.6477   | 0.4319   | 0.3027   | 0.3615   | 0.6598   | 0.9452       | 0.9927   | 0.9978 (94)    |
| Useful gains         | 525.0451  | 597.0774  | 688.1620  | 747.0980 | 641.4819 | 434.9157 | 287.6621 | 301.7685 | 462.1025 | 545.1228     | 508.9216 | 499.4887 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1159.2454 | 1123.6286 | 1022.6373 | 856.9596 | 656.0239 | 435.7620 | 287.7229 | 301.9617 | 473.5670 | 719.8358     | 953.8241 | 1152.5708 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 471.8450  | 353.8424  | 248.8496  | 79.1003  | 10.8192  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 129.9865     | 320.3298 | 485.8931 (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |              |          | 2100.6659 (98) |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |              |          | 22.7222 (99)   |
|                      |           |           |           |          |          |          |          |          |          | (98) / (4) = |          |                |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 2246.7015 | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 471.8450 | 353.8424 | 248.8496 | 79.1003  | 10.8192  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 129.9865 | 320.3298 | 485.8931  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 504.6470 | 378.4411 | 266.1493 | 84.5993  | 11.5714  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 139.0230 | 342.5987 | 519.6717  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 205.3541 | 180.9375 | 189.8775 | 170.0091 | 166.4560 | 148.5228 | 142.4389 | 156.5773 | 156.3878 | 176.2996 | 186.6747 | 200.3447  | (64)   |
| Efficiency of water heater                                            | 86.9640  | 86.5725  | 85.5362  | 82.9128  | 80.3800  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.0157  | 86.2423  | 79.8000   | (216)  |
| (217)m                                                                | 86.9640  | 86.5725  | 85.5362  | 82.9128  | 80.3800  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.0157  | 86.2423  | 87.0908   | (217)  |
| Fuel for water heating, kWh/month                                     | 236.1368 | 209.0011 | 221.9849 | 205.0458 | 207.0863 | 186.1189 | 178.4949 | 196.2122 | 195.9747 | 209.8414 | 216.4537 | 230.0413  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2492.3919 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2246.7015 | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 383.3950  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5197.4884 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2246.7015          | 0.2160                        | 485.2875 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2492.3919          | 0.2160                        | 538.3566 (264)           |
| Space and water heating                                                                           |                    |                               | 1023.6442 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 383.3950           | 0.5190                        | 198.9820 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1261.5512 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.0724 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1523 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4210 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.0724 * 1.00) + 2.1523 + 0.4210, rounded to 2 d.p. |                    |                               | 13.6500 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001158                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.11_1B |                |            |
| Property                           | B_2_13.11_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.62        | TER            | 15.87      |
| Environmental                      | 90 B                                | % DER<TER     | 7.88         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.78                                | DFEE          | 34.35        | TFEE           | 34.45      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 0.29         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 61 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.87 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.62 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)34.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)34.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 12.72 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.0300 (1b)              | x 2.5000 (2b)                   | = 152.5750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.0300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 152.5750 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total | m <sup>3</sup> per hour   |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-------|---------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                                      | 0               | +                    | 0                           | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                                               |                 |                      |                             |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |                             |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                                              |                 |                      |                             |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                                             |                 |                      |                             |       | Yes                       |
| Measured/design AP50                                                      |                 |                      |                             |       | 3.0000                    |
| Infiltration rate                                                         |                 |                      |                             |       | 0.1500 (18)               |
| Number of sides sheltered                                                 |                 |                      |                             |       | 3 (19)                    |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        |               |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Opening Type 1 (Uw = 1.40)                                  |                         |                            | 12.7200                   | 1.3258                        | 16.8636      |                                | (27)          |
| External Wall 1                                             | 22.5081                 | 12.7200                    | 9.7881                    | 0.1600                        | 1.5661       |                                | (29a)         |
| External Roof 1                                             | 18.2400                 |                            | 18.2400                   | 0.1600                        | 2.9184       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 40.7481                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            | (26)...(30) + (32) =      |                               | 21.3481      |                                | (33)          |
| Party Floor 1                                               |                         |                            | 61.0300                   |                               |              |                                | (32d)         |
| Party Ceilings 1                                            |                         |                            | 42.7900                   |                               |              |                                | (32b)         |

|                                                                |  |  |  |  |  |  |  |  |  |  |  |                            |
|----------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|----------------------------|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |  |  |  |  |  |  |  |  |  |  |  | 100.0000 (35)              |
| Thermal bridges (Default value 0.150 * total exposed area)     |  |  |  |  |  |  |  |  |  |  |  | 6.1122 (36)                |
| Total fabric heat loss                                         |  |  |  |  |  |  |  |  |  |  |  | (33) + (36) = 27.4603 (37) |

|                                                                     |              |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |              |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 13.1649      | 13.0186 | 12.8722 | 12.1406 | 11.9943 | 11.2626 | 11.2626 | 11.1163 | 11.5553 | 11.9943 | 12.2869 | 12.5796 (38) |
| Average = Sum(39)m / 12 =                                           | 40.6252      | 40.4789 | 40.3326 | 39.6009 | 39.4546 | 38.7230 | 38.7230 | 38.5766 | 39.0156 | 39.4546 | 39.7473 | 40.0399 (39) |
|                                                                     | 39.5643 (39) |         |         |         |         |         |         |         |         |         |         |              |
| HLP                                                                 | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 0.6657       | 0.6633  | 0.6609  | 0.6489  | 0.6465  | 0.6345  | 0.6345  | 0.6321  | 0.6393  | 0.6465  | 0.6513  | 0.6561 (40)  |
| Days in month                                                       |              |         |         |         |         |         |         |         |         |         |         | 0.6483 (40)  |
|                                                                     | 31           | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |         |         |          |          | 2.0106 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |         |         |          |          | 81.9518 (43)                      |
| Daily hot water use                      | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Energy conte                             | 90.1470  | 86.8689  | 83.5908  | 80.3128  | 77.0347  | 73.7566 | 73.7566 | 77.0347 | 80.3128 | 83.5908  | 86.8689  | 90.1470 (44)                      |
| Energy content (annual)                  | 133.6854 | 116.9221 | 120.6531 | 105.1883 | 100.9307 | 87.0955 | 80.7068 | 92.6122 | 93.7183 | 109.2196 | 119.2218 | 129.4671 (45)                     |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1289.4209 (45) |
| Water storage loss:                      | 20.0528  | 17.5383  | 18.0980  | 15.7782  | 15.1396  | 13.0643 | 12.1060 | 13.8918 | 14.0577 | 16.3829  | 17.8833  | 19.4201 (46)                      |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          |          | 110.0000 (47) |
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)   |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 32.0144                                                         | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | (56)          |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 32.0144                                                         | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | (57)          |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | (59)          |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 188.9622                                                        | 166.8495 | 175.9299 | 158.6820 | 156.2075 | 140.5892 | 135.9836 | 147.8890 | 147.2120 | 164.4964 | 172.7155 | 184.7439 | 184.7439 | (62)          |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63)          |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 188.9622                                                        | 166.8495 | 175.9299 | 158.6820 | 156.2075 | 140.5892 | 135.9836 | 147.8890 | 147.2120 | 164.4964 | 172.7155 | 184.7439 | 184.7439 | (64)          |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 88.6718                                                         | 78.8185  | 84.3386  | 77.7701  | 77.7809  | 71.7542  | 71.0564  | 75.0150  | 73.9563  | 80.5370  | 82.4362  | 87.2693  | 87.2693  | (65)          |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |          |      |
| Jan                                                                                 | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |          |      |
| (66)m                                                                               | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |          |      |
| 15.6492                                                                             | 13.8995  | 11.3039  | 8.5577   | 6.3970   | 5.4006   | 5.8356   | 7.5853   | 10.1810  | 12.9271  | 15.0878  | 16.0842  | 16.0842  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |          |      |
| 175.5369                                                                            | 177.3585 | 172.7683 | 162.9963 | 150.6610 | 139.0675 | 131.3224 | 129.5008 | 134.0910 | 143.8630 | 156.1983 | 167.7918 | 167.7918 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |          |      |
| 33.0530                                                                             | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | (69) |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |          |      |
| -80.4241                                                                            | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |          |      |
| 119.1826                                                                            | 117.2895 | 113.3583 | 108.0140 | 104.5442 | 99.6586  | 95.5060  | 100.8266 | 102.7171 | 108.2486 | 114.4947 | 117.2974 | 117.2974 | (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |          |      |
| 363.5278                                                                            | 361.7065 | 350.5895 | 332.7271 | 314.7612 | 297.2858 | 285.8229 | 291.0718 | 300.1481 | 318.1977 | 338.9398 | 354.3324 | 354.3324 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area     | Solar flux | g             | FF            |               |          | Access   |          |          | Gains        |
|-------------|----------|----------|----------|----------|------------|---------------|---------------|---------------|----------|----------|----------|----------|--------------|
|             |          |          |          | m2       | Table 6a   | Specific data | Specific data | Specific data |          | factor   |          |          | W            |
|             |          |          |          |          | W/m2       | or Table 6b   | or Table 6c   |               |          | Table 6d |          |          |              |
| Northeast   |          |          |          | 12.7200  | 11.2829    | 0.3000        | 0.8000        |               |          | 0.7700   |          |          | 23.8701 (75) |
| Solar gains | 23.8701  | 48.5882  | 87.5406  | 143.7667 | 193.2507   | 206.0257      | 192.7328      | 153.6489      | 106.6695 | 59.3787  | 30.0347  | 19.4935  | (83)         |
| Total gains | 387.3979 | 410.2948 | 438.1301 | 476.4938 | 508.0120   | 503.3115      | 478.5558      | 444.7206      | 406.8176 | 377.5764 | 368.9746 | 373.8259 | (84)         |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |         |              |
| Jan                                                                         | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |         |              |
| tau                                                                         | 41.7297 | 41.8805 | 42.0325 | 42.8090 | 42.9678 | 43.7797 | 43.7797 | 43.9457 | 43.4513 | 42.9678 | 42.6514 | 42.3397 |              |
| alpha                                                                       | 3.7820  | 3.7920  | 3.8022  | 3.8539  | 3.8645  | 3.9186  | 3.9186  | 3.9297  | 3.8968  | 3.8645  | 3.8434  | 3.8226  |              |
| util living area                                                            |         |         |         |         |         |         |         |         |         |         |         |         |              |
| 0.9447                                                                      | 0.9281  | 0.8885  | 0.7962  | 0.6505  | 0.4763  | 0.3520  | 0.3925  | 0.6101  | 0.8261  | 0.9180  | 0.9500  | 0.9500  | (86)         |
| MIT                                                                         | 19.9008 | 20.0460 | 20.3107 | 20.6465 | 20.8707 | 20.9712 | 20.9931 | 20.9896 | 20.9253 | 20.6510 | 20.2435 | 19.8786 | (87)         |
| Th 2                                                                        | 20.3713 | 20.3734 | 20.3755 | 20.3862 | 20.3883 | 20.3991 | 20.3991 | 20.4012 | 20.3948 | 20.3883 | 20.3841 | 20.3798 | (88)         |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |         |              |
| 0.9384                                                                      | 0.9201  | 0.8762  | 0.7751  | 0.6185  | 0.4355  | 0.3053  | 0.3435  | 0.5671  | 0.8033  | 0.9078  | 0.9444  | 0.9444  | (89)         |
| MIT 2                                                                       | 18.8805 | 19.0901 | 19.4682 | 19.9425 | 20.2398 | 20.3711 | 20.3938 | 20.3929 | 20.3173 | 19.9578 | 19.3834 | 18.8548 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.3897 | 19.5672 | 19.8887 | 20.2939 | 20.5547 | 20.6706 | 20.6929 | 20.6907 | 20.6207 | 20.3038 | 19.8127 | 19.3658 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 19.3897 | 19.5672 | 19.8887 | 20.2939 | 20.5547 | 20.6706 | 20.6929 | 20.6907 | 20.6207 | 20.3038 | 19.8127 | 19.3658 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                           |
| 0.9270               | 0.9083   | 0.8655   | 0.7718   | 0.6274   | 0.4541   | 0.3283   | 0.3673   | 0.5836   | 0.7999   | 0.8970   | 0.9334   | 0.9334   | (94)                      |
| Useful gains         | 359.1143 | 372.6727 | 379.2092 | 367.7559 | 318.7292 | 228.5754 | 157.0890 | 163.3676 | 237.4015 | 302.0282 | 330.9519 | 348.9343 | (95)                      |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000   | (96)                      |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |          |          |          |                           |
| 613.0238             | 593.7132 | 540.0001 | 451.2085 | 349.3573 | 235.0711 | 158.4903 | 165.5217 | 254.4106 | 382.8599 | 505.2941 | 607.2363 | 607.2363 | (97)                      |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | (97a)                     |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |          |          |          |                           |
| 188.9087             | 148.5392 | 119.6284 | 60.0858  | 22.7873  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 60.1388  | 125.5264 | 192.1767 | 192.1767 | (98)                      |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          |          |                           |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          |          |                           |
|                      |          |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 15.0384 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 917.7914 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 963.6810 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1940.2606 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2037.2737 (310a) |
| Electricity used for heat distribution                                                  | 30.0095 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 97.7243 (330a)   |
| Total electricity for the above, kWh/year                                               | 97.7243 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 276.3706 (332)   |
| Total delivered energy for all uses                                                     | 3375.0495 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 3158.8996          | 0.2160                        | 682.3223 (367)           |
| Electrical energy for heat distribution                                                    | 30.0095            | 0.5190                        | 15.5750 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 697.8973 (373)           |
| Space and water heating                                                                    |                    |                               | 697.8973 (376)           |
| Pumps and fans                                                                             | 97.7243            | 0.5190                        | 50.7189 (378)            |
| Energy for lighting                                                                        | 276.3706           | 0.5190                        | 143.4363 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 892.0525 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.6200 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 14.6200 ZC1 |
| Total Floor Area                                                                | TFA | 61.0300     |
| Assumed number of occupants                                                     | N   | 2.0106      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.0440 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.7405 ZC3  |
| Total CO2 emissions                                                             |     | 34.4045 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 34.4045 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.0300 (1b)              | x 2.5000 (2b)                   | = 152.5750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.0300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 152.5750 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1311 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3811 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.2953 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3766 | 0.3692 | 0.3618 | 0.3249 | 0.3175 | 0.2806 | 0.2806 | 0.2732 | 0.2953 | 0.3175 | 0.3323 | 0.3470 (22b) |
|                 | 0.5709 | 0.5681 | 0.5654 | 0.5528 | 0.5504 | 0.5394 | 0.5394 | 0.5373 | 0.5436 | 0.5504 | 0.5552 | 0.5602 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 12.7200                   | 1.3258                        | 16.8636      |                                | (27)          |
| External Wall 1                                                     | 22.5081                 | 12.7200                    | 9.7881                    | 0.1800                        | 1.7619       |                                | (29a)         |
| External Roof 1                                                     | 18.2400                 |                            | 18.2400                   | 0.1300                        | 2.3712       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 40.7481                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 20.9967      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 2.0374 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 23.0341 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 28.7446                 | 28.6059                    | 28.4701                   | 27.8319                       | 27.7125      | 27.1567                        | 27.1567       |
| Heat transfer coeff                                                 | 51.7787                 | 51.6400                    | 51.5042                   | 50.8660                       | 50.7466      | 50.1908                        | 50.1908       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 50.0878                        | 50.0878       |
|                                                                     | 50.4049                 | 50.7466                    | 50.9881                   | 51.2407                       | 51.4077      | 51.5707                        | 51.7337       |
| HLP                                                                 | 0.8484                  | 0.8461                     | 0.8439                    | 0.8335                        | 0.8315       | 0.8224                         | 0.8224        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.8207                         | 0.8207        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |          |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |          |          | 2.0106 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |          |          | 81.9518 (43)   |
| Daily hot water use                                         | 90.1470  | 86.8689  | 83.5908  | 80.3128  | 77.0347  | 73.7566 | 73.7566 | 77.0347 | 80.3128 | 83.5908  | 86.8689  | 90.1470 (44)   |
| Energy conte                                                | 133.6854 | 116.9221 | 120.6531 | 105.1883 | 100.9307 | 87.0955 | 80.7068 | 92.6122 | 93.7183 | 109.2196 | 119.2218 | 129.4671 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         |          |          | 1289.4209 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |         |         |          |          |                |
|                                                             | 20.0528  | 17.5383  | 18.0980  | 15.7782  | 15.1396  | 13.0643 | 12.1060 | 13.8918 | 14.0577 | 16.3829  | 17.8833  | 19.4201 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |          |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |          |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |          |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |          |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |          |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325  | 22.5798  | 23.3325 (56)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 180.2803 | 159.0078 | 167.2480 | 150.2801 | 147.5256 | 132.1873 | 127.3017 | 139.2071 | 138.8101 | 155.8145 | 164.3136 | 176.0620 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 180.2803 | 159.0078 | 167.2480 | 150.2801 | 147.5256 | 132.1873 | 127.3017 | 139.2071 | 138.8101 | 155.8145 | 164.3136 | 176.0620 (64) |
| Heat gains from water heating, kWh/month                        | 81.7263  | 72.5452  | 77.3931  | 71.0486  | 70.8354  | 65.0327  | 64.1109  | 68.0695  | 67.2348  | 73.5915  | 75.7147  | 80.3237 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.7008  | 13.9453  | 11.3411  | 8.5859   | 6.4181   | 5.4184   | 5.8548   | 7.6103   | 10.2145  | 12.9697  | 15.1375  | 16.1372 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 175.5369 | 177.3585 | 172.7683 | 162.9963 | 150.6610 | 139.0675 | 131.3224 | 129.5008 | 134.0910 | 143.8630 | 156.1983 | 167.7918 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 (71) |
| Water heating gains (Table 5)                                                       | 109.8472 | 107.9541 | 104.0230 | 98.6786  | 95.2088  | 90.3232  | 86.1706  | 91.4912  | 93.3817  | 98.9132  | 105.1593 | 107.9620 (72) |
| Total internal gains                                                                | 357.2440 | 355.4169 | 344.2914 | 326.4199 | 308.4470 | 290.9682 | 279.5068 | 284.7614 | 293.8462 | 311.9049 | 332.6542 | 348.0500 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          | 12.7200    | 11.2829                        | 0.6300                            |          | 0.7000                             | 0.7700                       |          | 43.8613 (75) |               |
| Solar gains | 43.8613  | 89.2809  | 160.8558 | 264.1714   | 355.0982                       | 378.5723                          | 354.1466 | 282.3298                           | 196.0053                     | 109.1083 | 55.1888      | 35.8193 (83)  |
| Total gains | 401.1052 | 444.6978 | 505.1472 | 590.5913   | 663.5451                       | 669.5405                          | 633.6534 | 567.0912                           | 489.8515                     | 421.0132 | 387.8430     | 383.8694 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 81.8521 | 82.0719 | 82.2884 | 83.3208 | 83.5168 | 84.4417 | 84.4417 | 84.6153 | 84.0830 | 83.5168 | 83.1212 | 82.7115      |
| alpha                                                                       | 6.4568  | 6.4715  | 6.4859  | 6.5547  | 6.5678  | 6.6294  | 6.6294  | 6.6410  | 6.6055  | 6.5678  | 6.5414  | 6.5141       |
| util living area                                                            | 0.9962  | 0.9918  | 0.9729  | 0.8848  | 0.6875  | 0.4778  | 0.3483  | 0.4057  | 0.6869  | 0.9440  | 0.9911  | 0.9971 (86)  |
| MIT                                                                         | 20.2427 | 20.3641 | 20.5839 | 20.8483 | 20.9743 | 20.9979 | 20.9998 | 20.9994 | 20.9815 | 20.7871 | 20.4706 | 20.2202 (87) |
| Th 2                                                                        | 20.2116 | 20.2135 | 20.2154 | 20.2244 | 20.2261 | 20.2340 | 20.2340 | 20.2354 | 20.2309 | 20.2261 | 20.2227 | 20.2191 (88) |
| util rest of house                                                          | 0.9951  | 0.9893  | 0.9648  | 0.8566  | 0.6378  | 0.4215  | 0.2878  | 0.3386  | 0.6194  | 0.9230  | 0.9879  | 0.9962 (89)  |
| MIT 2                                                                       | 19.1986 | 19.3764 | 19.6926 | 20.0566 | 20.2035 | 20.2327 | 20.2339 | 20.2352 | 20.2175 | 19.9870 | 19.5391 | 19.1718 (90) |
| Living area fraction                                                        | 19.7197 | 19.8694 | 20.1374 | 20.4518 | 20.5882 | 20.6146 | 20.6161 | 20.6166 | 20.5988 | 20.3864 | 20.0040 | 19.6951 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.7197 | 19.8694 | 20.1374 | 20.4518 | 20.5882 | 20.6146 | 20.6161 | 20.6166 | 20.5988 | 20.3864 | 20.0040 | 19.6951 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 0.9941   | 0.9879   | 0.9638   | 0.8654   | 0.6615   | 0.4496   | 0.3180   | 0.3721   | 0.6524   | 0.9279   | 0.9868   | 0.9954 (94)    |
| Ext temp.            | 398.7483 | 439.3368 | 486.8740 | 511.1053 | 438.9497 | 301.0316 | 201.5040 | 211.0137 | 319.5912 | 390.6502 | 382.7304 | 382.1191 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Month fracti         | 798.4104 | 773.0196 | 702.3838 | 587.5913 | 451.0463 | 301.8770 | 201.5733 | 211.2016 | 327.5707 | 496.6244 | 657.9501 | 793.9777 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 297.3486 | 224.2348 | 160.3393 | 55.0700  | 8.9999   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 78.8448  | 198.1582 | 306.4228 (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1329.4184 (98) |
|                      |          |          |          |          |          |          |          |          |          |          |          | 21.7830 (99)   |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1421.8379 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 297.3486 | 224.2348 | 160.3393 | 55.0700  | 8.9999   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 78.8448  | 198.1582 | 306.4228  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 318.0199 | 239.8234 | 171.4858 | 58.8984  | 9.6256   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.3260  | 211.9339 | 327.7249  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 180.2803 | 159.0078 | 167.2480 | 150.2801 | 147.5256 | 132.1873 | 127.3017 | 139.2071 | 138.8101 | 155.8145 | 164.3136 | 176.0620  | (64)            |
| Efficiency of water heater (217)m                                     | 86.1404  | 85.7306  | 84.7016  | 82.4131  | 80.3462  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.1012  | 85.3144  | 86.2785   | (217)           |
| Fuel for water heating, kWh/month                                     | 209.2865 | 185.4737 | 197.4555 | 182.3499 | 183.6124 | 165.6483 | 159.5259 | 174.4450 | 173.9475 | 187.4996 | 192.5978 | 204.0624  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2215.9047 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1421.8379 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 277.2812  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3990.0238 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1421.8379          | 0.2160                        | 307.1170 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2215.9047          | 0.2160                        | 478.6354 (264)           |
| Space and water heating                                                                           |                    |                               | 785.7524 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 277.2812           | 0.5190                        | 143.9090 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 968.5864 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.8749 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3580 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6378 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.8749 * 1.00) + 2.3580 + 0.6378, rounded to 2 d.p. |                    |                               | 15.8700 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001202                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.11_1B |                |            |
| Property                           | B_2_13.11_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 13.36        | TER            | 15.87      |
| Environmental                      | 90 B                                | % DER<TER     | 15.82        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.73                                | DFEE          | 29.07        | TFEE           | 34.45      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 15.63        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 61 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.87 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 13.36 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)34.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)29.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing North East: | 12.72 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.0300 (1b)              | x 2.5000 (2b)                   | = 152.5750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.0300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 152.5750 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| Opening Type 1 (Uw = 1.00)                                     |                         |                            | 12.7200                   | 0.9615                        | 12.2308      |                                | (27)                       |
| External Wall 1                                                | 22.5081                 | 12.7200                    | 9.7881                    | 0.1600                        | 1.5661       |                                | (29a)                      |
| External Roof 1                                                | 18.2400                 |                            | 18.2400                   | 0.1600                        | 2.9184       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 40.7481                   |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 16.7153      |                                | (33)                       |
| Party Floor 1                                                  |                         |                            | 61.0300                   |                               |              |                                | (32d)                      |
| Party Ceilings 1                                               |                         |                            | 42.7900                   |                               |              |                                | (32b)                      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 100.0000 (35)              |
| Thermal bridges (Default value 0.150 * total exposed area)     |                         |                            |                           |                               |              |                                | 6.1122 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 22.8275 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 13.1649 | 13.0186 | 12.8722 | 12.1406 | 11.9943 | 11.2626 | 11.2626 | 11.1163 | 11.5553 | 11.9943 | 12.2869 | 12.5796 (38) |
| Heat transfer coeff       | 35.9924 | 35.8460 | 35.6997 | 34.9681 | 34.8217 | 34.0901 | 34.0901 | 33.9438 | 34.3827 | 34.8217 | 35.1144 | 35.4071 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 34.9315 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.5897 | 0.5874 | 0.5850 | 0.5730 | 0.5706 | 0.5586 | 0.5586 | 0.5562 | 0.5634 | 0.5706 | 0.5754 | 0.5802 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.5724 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.0106 (42)  |
| Average daily hot water use (litres/day) | 81.9518 (43) |

|                                        | Jan                | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec            |
|----------------------------------------|--------------------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|----------------|
| Daily hot water use                    | 90.1470            | 86.8689  | 83.5908  | 80.3128  | 77.0347  | 73.7566 | 73.7566 | 77.0347 | 80.3128 | 83.5908  | 86.8689  | 90.1470 (44)   |
| Energy conte                           | 133.6854           | 116.9221 | 120.6531 | 105.1883 | 100.9307 | 87.0955 | 80.7068 | 92.6122 | 93.7183 | 109.2196 | 119.2218 | 129.4671 (45)  |
| Energy content (annual)                | Total = Sum(45)m = |          |          |          |          |         |         |         |         |          |          | 1289.4209 (45) |
| Distribution loss (46)m = 0.15 x (45)m | 20.0528            | 17.5383  | 18.0980  | 15.7782  | 15.1396  | 13.0643 | 12.1060 | 13.8918 | 14.0577 | 16.3829  | 17.8833  | 19.4201 (46)   |
| Water storage loss:                    |                    |          |          |          |          |         |         |         |         |          |          |                |



|                                                                 |                                          |          |          |          |          |          |          |          |          |          |          |           |      |
|-----------------------------------------------------------------|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|------|
| Store volume                                                    |                                          |          |          |          |          |          |          |          |          |          |          | 110.0000  | (47) |
| b) If manufacturer declared loss factor is not known :          |                                          |          |          |          |          |          |          |          |          |          |          |           |      |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |                                          |          |          |          |          |          |          |          |          |          |          | 0.0152    | (51) |
| Volume factor from Table 2a                                     |                                          |          |          |          |          |          |          |          |          |          |          | 1.0294    | (52) |
| Temperature factor from Table 2b                                |                                          |          |          |          |          |          |          |          |          |          |          | 0.6000    | (53) |
| Enter (49) or (54) in (55)                                      |                                          |          |          |          |          |          |          |          |          |          |          | 1.0327    | (55) |
| Total storage loss                                              | 32.0144                                  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144   | (56) |
| If cylinder contains dedicated solar storage                    | 32.0144                                  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144   | (57) |
| Primary loss                                                    | 23.2624                                  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624   | (59) |
| Total heat required for water heating calculated for each month | 188.9622                                 | 166.8495 | 175.9299 | 158.6820 | 156.2075 | 140.5892 | 135.9836 | 147.8890 | 147.2120 | 164.4964 | 172.7155 | 184.7439  | (62) |
| Solar input                                                     | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (63) |
|                                                                 | Solar input (sum of months) = Sum(63)m = |          |          |          |          |          |          |          |          |          |          | 0.0000    | (63) |
| Output from w/h                                                 | 188.9622                                 | 166.8495 | 175.9299 | 158.6820 | 156.2075 | 140.5892 | 135.9836 | 147.8890 | 147.2120 | 164.4964 | 172.7155 | 184.7439  | (64) |
|                                                                 | Total per year (kWh/year) = Sum(64)m =   |          |          |          |          |          |          |          |          |          |          | 1940.2606 | (64) |
| Heat gains from water heating, kWh/month                        | 88.6718                                  | 78.8185  | 84.3386  | 77.7701  | 77.7809  | 71.7542  | 71.0564  | 75.0150  | 73.9563  | 80.5370  | 82.4362  | 87.2693   | (65) |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.6492  | 13.8995  | 11.3039  | 8.5577   | 6.3970   | 5.4006   | 5.8356   | 7.5853   | 10.1810  | 12.9271  | 15.0878  | 16.0842 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 175.5369 | 177.3585 | 172.7683 | 162.9963 | 150.6610 | 139.0675 | 131.3224 | 129.5008 | 134.0910 | 143.8630 | 156.1983 | 167.7918 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 (71) |
| Water heating gains (Table 5)                                                       | 119.1826 | 117.2895 | 113.3583 | 108.0140 | 104.5442 | 99.6586  | 95.5060  | 100.8266 | 102.7171 | 108.2486 | 114.4947 | 117.2974 (72) |
| Total internal gains                                                                | 363.5278 | 361.7065 | 350.5895 | 332.7271 | 314.7612 | 297.2858 | 285.8229 | 291.0718 | 300.1481 | 318.1977 | 338.9398 | 354.3324 (73) |

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |  |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|------------------------------|----------|---------------|--|
| -----       |          |          |          |          |            |                                |                                   |          |                                    |                              |          |               |  |
| Northeast   |          |          |          |          | 12.7200    | 11.2829                        | 0.5000                            |          | 0.8000                             | 0.7700                       |          | 39.7835 (75)  |  |
| -----       |          |          |          |          |            |                                |                                   |          |                                    |                              |          |               |  |
| Solar gains | 39.7835  | 80.9804  | 145.9009 | 239.6112 | 322.0845   | 343.3762                       | 321.2214                          | 256.0814 | 177.7826                           | 98.9645                      | 50.0579  | 32.4892 (83)  |  |
| Total gains | 403.3113 | 442.6869 | 496.4904 | 572.3383 | 636.8458   | 640.6620                       | 607.0443                          | 547.1532 | 477.9306                           | 417.1622                     | 388.9977 | 386.8216 (84) |  |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 47.1010 | 47.2933 | 47.4872 | 48.4807 | 48.6845 | 49.7293 | 49.7293 | 49.9437 | 49.3061                   | 48.6845 | 48.2787 | 47.8797      |
| alpha                                                                       | 4.1401  | 4.1529  | 4.1658  | 4.2320  | 4.2456  | 4.3153  | 4.3153  | 4.3296  | 4.2871                    | 4.2456  | 4.2186  | 4.1920       |
| util living area                                                            |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | 0.9276  | 0.8961  | 0.8229  | 0.6717  | 0.4939  | 0.3384  | 0.2466  | 0.2845  | 0.4837                    | 0.7482  | 0.8877  | 0.9355 (86)  |
| MIT                                                                         | 20.1756 | 20.3438 | 20.6029 | 20.8585 | 20.9660 | 20.9949 | 20.9990 | 20.9982 | 20.9777                   | 20.8168 | 20.4781 | 20.1503 (87) |
| Th 2                                                                        | 20.4392 | 20.4414 | 20.4436 | 20.4544 | 20.4566 | 20.4674 | 20.4674 | 20.4696 | 20.4631                   | 20.4566 | 20.4522 | 20.4479 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | 0.9203  | 0.8861  | 0.8075  | 0.6492  | 0.4676  | 0.3108  | 0.2170  | 0.2520  | 0.4489                    | 0.7233  | 0.8756  | 0.9289 (89)  |
| MIT 2                                                                       | 19.3234 | 19.5635 | 19.9270 | 20.2804 | 20.4184 | 20.4625 | 20.4667 | 20.4682 | 20.4403                   | 20.2341 | 19.7656 | 19.2941 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4991 (91)  |
| MIT                                                                         | 19.7487 | 19.9530 | 20.2643 | 20.5689 | 20.6917 | 20.7282 | 20.7323 | 20.7327 | 20.7085                   | 20.5249 | 20.1212 | 19.7214 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.7487 | 19.9530 | 20.2643 | 20.5689 | 20.6917 | 20.7282 | 20.7323 | 20.7327 | 20.7085                   | 20.5249 | 20.1212 | 19.7214 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.9101   | 0.8766   | 0.8022   | 0.6540   | 0.4791   | 0.3243   | 0.2317   | 0.2681   | 0.4649   | 0.7266       | 0.8675   | 0.9190 (94)    |
| Useful gains         | 367.0357 | 388.0378 | 398.2984 | 374.3225 | 305.1015 | 207.7913 | 140.6741 | 146.7037 | 222.2009 | 303.0979     | 337.4723 | 355.4759 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 556.0364 | 539.5899 | 491.3832 | 408.0393 | 313.1064 | 208.9122 | 140.8722 | 147.0681 | 227.2182 | 345.6021     | 457.2313 | 549.5669 (97a) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 140.6166 | 101.8430 | 69.2551  | 24.2761  | 5.9556   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 31.6231      | 86.2265  | 144.4037 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 604.1996 (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 9.9000 (99)    |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 604.1996 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 634.4096 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1940.2606 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2037.2737 (310a) |
| Electricity used for heat distribution                                                  | 26.7168 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 97.7243 (330a)   |
| Total electricity for the above, kWh/year                                               | 97.7243 (331)    |
| Electricity for lighting (calculated in Appendix L)                                     | 276.3706 (332)   |
| Total delivered energy for all uses                                                     | 3045.7782 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2812.2982          | 0.2160                        | 607.4564 (367)           |
| Electrical energy for heat distribution                                                    | 26.7168            | 0.5190                        | 13.8660 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 621.3224 (373)           |
| Space and water heating                                                                    |                    |                               | 621.3224 (376)           |
| Pumps and fans                                                                             | 97.7243            | 0.5190                        | 50.7189 (378)            |
| Energy for lighting                                                                        | 276.3706           | 0.5190                        | 143.4363 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 815.4777 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 13.3600 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 13.3600 ZC1 |
| Total Floor Area                                                                | 61.0300     |
| Assumed number of occupants                                                     | 2.0106      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   | 17.0440 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.7405 ZC3  |
| Total CO2 emissions                                                             | 33.1445 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 33.1445 ZC8 |

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 61.0300 (1b)              | x 2.5000 (2b)                   | = 152.5750 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 61.0300                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 152.5750 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total    | m <sup>3</sup> per hour |
|------------------------------------------------------|------------------------------|----------------------|-------|----------|-------------------------|
| Number of chimneys                                   | 0                            | 0                    | 0     | 0 * 40 = | 0.0000 (6a)             |
| Number of open flues                                 | 0                            | 0                    | 0     | 0 * 20 = | 0.0000 (6b)             |
| Number of intermittent fans                          |                              |                      |       | 2 * 10 = | 20.0000 (7a)            |
| Number of passive vents                              |                              |                      |       | 0 * 10 = | 0.0000 (7b)             |
| Number of flueless gas fires                         |                              |                      |       | 0 * 40 = | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |          | Air changes per hour    |
| Pressure test                                        |                              |                      |       |          | 20.0000 / (5) =         |
| Measured/design AP50                                 |                              |                      |       |          | Yes                     |
| Infiltration rate                                    |                              |                      |       |          | 5.0000                  |
| Number of sides sheltered                            |                              |                      |       |          | 0.3811 (18)             |
|                                                      |                              |                      |       |          | 3 (19)                  |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |          | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |          | 0.2953 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3766 | 0.3692 | 0.3618 | 0.3249 | 0.3175 | 0.2806 | 0.2806 | 0.2732 | 0.2953 | 0.3175 | 0.3323 | 0.3470 (22b) |
| Effective ac    | 0.5709 | 0.5681 | 0.5654 | 0.5528 | 0.5504 | 0.5394 | 0.5394 | 0.5373 | 0.5436 | 0.5504 | 0.5552 | 0.5602 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                |                         |                            | 12.7200                   | 1.3258                        | 16.8636      |                                | (27)          |
| External Wall 1                                             | 22.5081                 | 12.7200                    | 9.7881                    | 0.1800                        | 1.7619       |                                | (29a)         |
| External Roof 1                                             | 18.2400                 |                            | 18.2400                   | 0.1300                        | 2.3712       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 40.7481                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            | (26)...(30) + (32) =      |                               | 20.9967      |                                | (33)          |

|                                                                 |                            |
|-----------------------------------------------------------------|----------------------------|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K  | 250.0000 (35)              |
| Thermal bridges (User defined value 0.050 * total exposed area) | 2.0374 (36)                |
| Total fabric heat loss                                          | (33) + (36) = 23.0341 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 28.7446 | 28.6059 | 28.4701 | 27.8319 | 27.7125 | 27.1567 | 27.1567 | 27.0537 | 27.3708 | 27.7125 | 27.9540 | 28.2066 (38) |
| Heat transfer coeff       | 51.7787 | 51.6400 | 51.5042 | 50.8660 | 50.7466 | 50.1908 | 50.1908 | 50.0878 | 50.4049 | 50.7466 | 50.9881 | 51.2407 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 50.8654 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8484 | 0.8461 | 0.8439 | 0.8335 | 0.8315 | 0.8224 | 0.8224 | 0.8207 | 0.8259 | 0.8315 | 0.8355 | 0.8396 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8334 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.0106 (42)  |
| Average daily hot water use (litres/day) | 81.9518 (43) |

|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Daily hot water use                                         | 90.1470  | 86.8689  | 83.5908  | 80.3128  | 77.0347  | 73.7566 | 73.7566 | 77.0347 | 80.3128 | 83.5908  | 86.8689  | 90.1470 (44)                      |
| Energy conte                                                | 133.6854 | 116.9221 | 120.6531 | 105.1883 | 100.9307 | 87.0955 | 80.7068 | 92.6122 | 93.7183 | 109.2196 | 119.2218 | 129.4671 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1289.4209 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 20.0528  | 17.5383  | 18.0980  | 15.7782  | 15.1396  | 13.0643 | 12.1060 | 13.8918 | 14.0577 | 16.3829  | 17.8833  | 19.4201 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |          |          |                                   |
| Store volume                                                |          |          |          |          |          |         |         |         |         |          |          | 150.0000 (47)                     |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |          |          | 1.3938 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |          |          | 0.7527 (55)                       |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325  | 22.5798  | 23.3325 (56)                      |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |                                                        |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|--------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    |                                                        |          |          |          |          |          |          |          |          |          |          |               |
| Primary loss                                                    | 23.3325                                                | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Total heat required for water heating calculated for each month | 23.2624                                                | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 180.2803                                               | 159.0078 | 167.2480 | 150.2801 | 147.5256 | 132.1873 | 127.3017 | 139.2071 | 138.8101 | 155.8145 | 164.3136 | 176.0620 (62) |
| Output from w/h                                                 | 0.0000                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | Solar input (sum of months) = Sum (63)m = 0.0000 (63)  |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 180.2803                                               | 159.0078 | 167.2480 | 150.2801 | 147.5256 | 132.1873 | 127.3017 | 139.2071 | 138.8101 | 155.8145 | 164.3136 | 176.0620 (64) |
|                                                                 | Total per year (kWh/year) = Sum (64)m = 1838.0383 (64) |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 81.7263                                                | 72.5452  | 77.3931  | 71.0486  | 70.8354  | 65.0327  | 64.1109  | 68.0695  | 67.2348  | 73.5915  | 75.7147  | 80.3237 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 | 100.5301 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 15.7008  | 13.9453  | 11.3411  | 8.5859   | 6.4181   | 5.4184   | 5.8548   | 7.6103   | 10.2145  | 12.9697  | 15.1375  | 16.1372 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 175.5369 | 177.3585 | 172.7683 | 162.9963 | 150.6610 | 139.0675 | 131.3224 | 129.5008 | 134.0910 | 143.8630 | 156.1983 | 167.7918 (68) |
| Pumps, fans                                                                         | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530  | 33.0530 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Water heating gains (Table 5)                                                       | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 | -80.4241 (71) |
| Total internal gains                                                                | 109.8472 | 107.9541 | 104.0230 | 98.6786  | 95.2088  | 90.3232  | 86.1706  | 91.4912  | 93.3817  | 98.9132  | 105.1593 | 107.9620 (72) |
|                                                                                     | 357.2440 | 355.4169 | 344.2914 | 326.4199 | 308.4470 | 290.9682 | 279.5068 | 284.7614 | 293.8462 | 311.9049 | 332.6542 | 348.0500 (73) |

#### 6. Solar gains

|             |          |          |            |          |               |          |               |          |          |          |              |               |
|-------------|----------|----------|------------|----------|---------------|----------|---------------|----------|----------|----------|--------------|---------------|
| [Jan]       | Area     |          | Solar flux |          | g             |          | FF            |          | Access   |          | Gains        |               |
|             | m2       |          | Table 6a   |          | Specific data |          | Specific data |          | factor   |          | W            |               |
|             |          |          | W/m2       |          | or Table 6b   |          | or Table 6c   |          | Table 6d |          |              |               |
| Northeast   | 12.7200  |          | 11.2829    |          | 0.6300        |          | 0.7000        |          | 0.7700   |          | 43.8613 (75) |               |
| Solar gains | 43.8613  | 89.2809  | 160.8558   | 264.1714 | 355.0982      | 378.5723 | 354.1466      | 282.3298 | 196.0053 | 109.1083 | 55.1888      | 35.8193 (83)  |
| Total gains | 401.1052 | 444.6978 | 505.1472   | 590.5913 | 663.5451      | 669.5405 | 633.6534      | 567.0912 | 489.8515 | 421.0132 | 387.8430     | 383.8694 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |                                       |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |                                       |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                                       |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| tau                                                                         | Jan                                   | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| alpha                                                                       | 81.8521                               | 82.0719 | 82.2884 | 83.3208 | 83.5168 | 84.4417 | 84.4417 | 84.6153 | 84.0830 | 83.5168 | 83.1212 | 82.7115      |
| util living area                                                            | 6.4568                                | 6.4715  | 6.4859  | 6.5547  | 6.5678  | 6.6294  | 6.6294  | 6.6410  | 6.6055  | 6.5678  | 6.5414  | 6.5141       |
|                                                                             | 0.9962                                | 0.9918  | 0.9729  | 0.8848  | 0.6875  | 0.4778  | 0.3483  | 0.4057  | 0.6869  | 0.9440  | 0.9911  | 0.9971 (86)  |
| MIT                                                                         | 20.2427                               | 20.3641 | 20.5839 | 20.8483 | 20.9743 | 20.9979 | 20.9998 | 20.9994 | 20.9815 | 20.7871 | 20.4706 | 20.2202 (87) |
| Th 2                                                                        | 20.2116                               | 20.2135 | 20.2154 | 20.2244 | 20.2261 | 20.2340 | 20.2340 | 20.2354 | 20.2309 | 20.2261 | 20.2227 | 20.2191 (88) |
| util rest of house                                                          | 0.9951                                | 0.9893  | 0.9648  | 0.8566  | 0.6378  | 0.4215  | 0.2878  | 0.3386  | 0.6194  | 0.9230  | 0.9879  | 0.9962 (89)  |
| MIT 2                                                                       | 19.1986                               | 19.3764 | 19.6926 | 20.0566 | 20.2035 | 20.2327 | 20.2339 | 20.2352 | 20.2175 | 19.9870 | 19.5391 | 19.1718 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = 0.4991 (91) |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.7197                               | 19.8694 | 20.1374 | 20.4518 | 20.5882 | 20.6146 | 20.6161 | 20.6166 | 20.5988 | 20.3864 | 20.0040 | 19.6951 (92) |
| Temperature adjustment                                                      | 0.0000                                |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 19.7197                               | 19.8694 | 20.1374 | 20.4518 | 20.5882 | 20.6146 | 20.6161 | 20.6166 | 20.5988 | 20.3864 | 20.0040 | 19.6951 (93) |

#### 8. Space heating requirement

|                      |                           |          |          |          |          |          |          |          |          |          |          |               |
|----------------------|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation          | Jan                       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Useful gains         | 0.9941                    | 0.9879   | 0.9638   | 0.8654   | 0.6615   | 0.4496   | 0.3180   | 0.3721   | 0.6524   | 0.9279   | 0.9868   | 0.9954 (94)   |
| Ext temp.            | 398.7483                  | 439.3368 | 486.8740 | 511.1053 | 438.9497 | 301.0316 | 201.5040 | 211.0137 | 319.5912 | 390.6502 | 382.7304 | 382.1191 (95) |
| Heat loss rate W     | 4.3000                    | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Month fracti         | 798.4104                  | 773.0196 | 702.3838 | 587.5913 | 451.0463 | 301.8770 | 201.5733 | 211.2016 | 327.5707 | 496.6244 | 657.9501 | 793.9777 (97) |
| Space heating kWh    | 1.0000                    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating per m2 | 297.3486                  | 224.2348 | 160.3393 | 55.0700  | 8.9999   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 78.8448  | 198.1582 | 306.4228 (98) |
|                      | (98) / (4) = 21.7830 (99) |          |          |          |          |          |          |          |          |          |          |               |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1421.8379 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 297.3486 | 224.2348 | 160.3393 | 55.0700  | 8.9999   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 78.8448  | 198.1582 | 306.4228  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 318.0199 | 239.8234 | 171.4858 | 58.8984  | 9.6256   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.3260  | 211.9339 | 327.7249  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 180.2803 | 159.0078 | 167.2480 | 150.2801 | 147.5256 | 132.1873 | 127.3017 | 139.2071 | 138.8101 | 155.8145 | 164.3136 | 176.0620  | (64)            |
| Efficiency of water heater (217)m                                     | 86.1404  | 85.7306  | 84.7016  | 82.4131  | 80.3462  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.1012  | 85.3144  | 86.2785   | (217)           |
| Fuel for water heating, kWh/month                                     | 209.2865 | 185.4737 | 197.4555 | 182.3499 | 183.6124 | 165.6483 | 159.5259 | 174.4450 | 173.9475 | 187.4996 | 192.5978 | 204.0624  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2215.9047 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1421.8379 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 277.2812  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3990.0238 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1421.8379          | 0.2160                        | 307.1170 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2215.9047          | 0.2160                        | 478.6354 (264)           |
| Space and water heating                                                                           |                    |                               | 785.7524 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 277.2812           | 0.5190                        | 143.9090 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 968.5864 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.8749 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3580 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6378 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.8749 * 1.00) + 2.3580 + 0.6378, rounded to 2 d.p. |                    |                               | 15.8700 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001230                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.12_2B |                |            |
| Property                           | B_2_13.12_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 84 B                                | DER           | 15.75        | TER            | 14.39      |
| Environmental                      | 86 B                                | % DER<TER     | -9.43        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.48                                | DFEE          | 50.06        | TFEE           | 42.54      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -17.66       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 110 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.39 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.75 kgCO<sub>2</sub>/m<sup>2</sup> Fail  
Excess emissions = 1.36 kgCO<sub>2</sub>/m<sup>2</sup> (9.5%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 42.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 50.1 kWh/m<sup>2</sup>/yr Fail  
Excess energy = 7.6 kWh/m<sup>2</sup>/yr (17.9%)

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof             | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings         | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                            |    |
|-------------------------|--------------------------------------------------------------------------------------------|----|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room stats | OK |
|-------------------------|--------------------------------------------------------------------------------------------|----|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                      |      |    |
|------------------------------------------------------|------|----|
| Percentage of fixed lights with low-energy fittings: | 100% |    |
| Minimum                                              | 75%  | OK |

#### 8 Mechanical ventilation

|                                      |      |    |
|--------------------------------------|------|----|
| Continuous supply and extract system |      |    |
| Specific fan power:                  | 0.44 |    |
| Maximum                              | 1.5  | OK |
| MVHR efficiency:                     | 91%  |    |
| Minimum:                             | 70%  | OK |

#### 9 Summertime temperature

|                                   |        |    |
|-----------------------------------|--------|----|
| Overheating risk (Thames Valley): | Medium | OK |
|-----------------------------------|--------|----|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South East: | 12.00 m <sup>2</sup> , No overhang |
| Windows facing South West: | 13.20 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 109.8600 (1b)             | x 2.5000 (2b)                   | = 274.6500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 109.8600                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 274.6500 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    |        | secondary |        |        |        | other  |        | total                                   | m3 per hour |  |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|--------|-----------|--------|--------|--------|--------|--------|-----------------------------------------|-------------|--|
|                                                                                              |        |        |        |        | heating | +      | heating   |        |        |        | =      |        | 0 * 40 =                                | 0.0000 (6a) |  |
|                                                                                              |        |        |        |        | 0       | +      | 0         | +      |        | 0      | =      |        | 0 * 20 =                                | 0.0000 (6b) |  |
|                                                                                              |        |        |        |        | 0       | +      | 0         | +      |        | 0      | =      |        | 0 * 10 =                                | 0.0000 (7a) |  |
| Number of intermittent fans                                                                  |        |        |        |        |         |        |           |        |        |        |        |        | 0 * 10 =                                | 0.0000 (7b) |  |
| Number of passive vents                                                                      |        |        |        |        |         |        |           |        |        |        |        |        | 0 * 10 =                                | 0.0000 (7c) |  |
| Number of flueless gas fires                                                                 |        |        |        |        |         |        |           |        |        |        |        |        | 0 * 40 =                                | 0.0000 (7c) |  |
|                                                                                              |        |        |        |        |         |        |           |        |        |        |        |        | Air changes per hour                    |             |  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                    |        |        |        |        |         |        |           |        |        |        |        |        | 0.0000 / (5) = 0.0000 (8)               |             |  |
| Pressure test                                                                                |        |        |        |        |         |        |           |        |        |        |        |        | Yes                                     |             |  |
| Measured/design AP50                                                                         |        |        |        |        |         |        |           |        |        |        |        |        | 3.0000                                  |             |  |
| Infiltration rate                                                                            |        |        |        |        |         |        |           |        |        |        |        |        | 0.1500 (18)                             |             |  |
| Number of sides sheltered                                                                    |        |        |        |        |         |        |           |        |        |        |        |        | 2 (19)                                  |             |  |
| Shelter factor                                                                               |        |        |        |        |         |        |           |        |        |        |        |        | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |             |  |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |        |           |        |        |        |        |        | (21) = (18) x (20) = 0.1275 (21)        |             |  |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun    | Jul       | Aug    | Sep    | Oct    | Nov    | Dec    |                                         |             |  |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000 | 3.8000    | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22)                                    |             |  |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500 | 0.9500    | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a)                                   |             |  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371  | 0.1211 | 0.1211    | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498 | (22b)                                   |             |  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |        |           |        |        |        |        |        |                                         |             |  |
| If mechanical ventilation:                                                                   |        |        |        |        |         |        |           |        |        |        |        |        | 0.5000 (23a)                            |             |  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |        |           |        |        |        |        |        | 77.3500 (23c)                           |             |  |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503  | 0.2344 | 0.2344    | 0.2312 | 0.2408 | 0.2503 | 0.2567 | 0.2631 | (25)                                    |             |  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K              |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|------------------------|------------------|----------------|-------------------|----------------------------|----------------|----------------|----------------|----------------|---------------------|
| Opening Type 1 (Uw = 1.40)                                          |                |                | 25.2000                | 1.3258           | 33.4091        |                   | (27)                       |                |                |                |                |                     |
| External Wall 1                                                     | 83.0636        | 25.2000        | 57.8636                | 0.1600           | 9.2582         |                   | (29a)                      |                |                |                |                |                     |
| External Roof 1                                                     | 103.0300       |                | 103.0300               | 0.1600           | 16.4848        |                   | (30)                       |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 186.0936               |                  |                |                   | (31)                       |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26) ... (30) + (32) = |                  | 59.1521        |                   | (33)                       |                |                |                |                |                     |
| Party Floor 1                                                       |                |                | 109.8600               |                  |                |                   | (32d)                      |                |                |                |                |                     |
| Party Ceilings 1                                                    |                |                | 6.8400                 |                  |                |                   | (32b)                      |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                        |                  |                |                   | 100.0000 (35)              |                |                |                |                |                     |
| Thermal bridges (Default value 0.150 * total exposed area)          |                |                |                        |                  |                |                   | 27.9140 (36)               |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                        |                  |                |                   | (33) + (36) = 87.0661 (37) |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                        |                  |                |                   |                            |                |                |                |                |                     |
| (38)m                                                               | Jan<br>24.9981 | Feb<br>24.7092 | Mar<br>24.4203         | Apr<br>22.9758   | May<br>22.6869 | Jun<br>21.2425    | Jul<br>21.2425             | Aug<br>20.9536 | Sep<br>21.8203 | Oct<br>22.6869 | Nov<br>23.2647 | Dec<br>23.8425 (38) |
| Heat transfer coeff                                                 | 112.0642       | 111.7753       | 111.4864               | 110.0420         | 109.7531       | 108.3086          | 108.3086                   | 108.0197       | 108.8864       | 109.7531       | 110.3309       | 110.9086 (39)       |
| Average = Sum(39)m / 12 =                                           |                |                |                        |                  |                |                   |                            |                |                |                |                | 109.9697 (39)       |
| HLP                                                                 | Jan<br>1.0201  | Feb<br>1.0174  | Mar<br>1.0148          | Apr<br>1.0017    | May<br>0.9990  | Jun<br>0.9859     | Jul<br>0.9859              | Aug<br>0.9832  | Sep<br>0.9911  | Oct<br>0.9990  | Nov<br>1.0043  | Dec<br>1.0095 (40)  |
| HLP (average)                                                       |                |                |                        |                  |                |                   |                            |                |                |                |                | 1.0010 (40)         |
| Days in month                                                       | 31             | 28             | 31                     | 30               | 31             | 30                | 31                         | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |              |             |             |             |             |             |             |              |              |                                   |
|------------------------------------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|-----------------------------------|
| Assumed occupancy                        |              |              |              |             |             |             |             |             |             |              |              | 2.8140 (42)                       |
| Average daily hot water use (litres/day) |              |              |              |             |             |             |             |             |             |              |              | 101.0321 (43)                     |
| Daily hot water use                      | Jan 111.1353 | Feb 107.0940 | Mar 103.0527 | Apr 99.0115 | May 94.9702 | Jun 90.9289 | Jul 90.9289 | Aug 94.9702 | Sep 99.0115 | Oct 103.0527 | Nov 107.0940 | Dec 111.1353 (44)                 |
| Energy conte                             | 164.8104     | 144.1443     | 148.7440     | 129.6786    | 124.4297    | 107.3734    | 99.4972     | 114.1745    | 115.5381    | 134.6485     | 146.9794     | 159.6101 (45)                     |
| Energy content (annual)                  |              |              |              |             |             |             |             |             |             |              |              | Total = Sum(45)m = 1589.6283 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |              |              |              |             |             |             |             |             |             |              |              |                                   |
|                                          | 24.7216      | 21.6216      | 22.3116      | 19.4518     | 18.6645     | 16.1060     | 14.9246     | 17.1262     | 17.3307     | 20.1973      | 22.0469      | 23.9415 (46)                      |
| Water storage loss:                      |              |              |              |             |             |             |             |             |             |              |              |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          |          | 110.0000 (47) |
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          |          | 0.0152 (51)   |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          |          | 1.0294 (52)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (53)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          |          | 1.0327 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 32.0144                                                         | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | (56)          |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 32.0144                                                         | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144  | (57)          |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | (59)          |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 220.0872                                                        | 194.0717 | 204.0208 | 183.1723 | 179.7065 | 160.8671 | 154.7740 | 169.4513 | 169.0318 | 189.9253 | 200.4731 | 214.8869 | 214.8869 | (62)          |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63)          |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 220.0872                                                        | 194.0717 | 204.0208 | 183.1723 | 179.7065 | 160.8671 | 154.7740 | 169.4513 | 169.0318 | 189.9253 | 200.4731 | 214.8869 | 214.8869 | (64)          |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 99.0209                                                         | 87.8699  | 93.6788  | 85.9131  | 85.5943  | 78.4966  | 77.3043  | 82.1845  | 81.2114  | 88.9921  | 91.6656  | 97.2918  | 97.2918  | (65)          |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| Jan                                                                                 | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |           |      |
| (66)m                                                                               | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 24.1915                                                                             | 21.4867   | 17.4741   | 13.2290   | 9.8889    | 8.3486    | 9.0209    | 11.7258   | 15.7383   | 19.9834   | 23.3236   | 24.8638   | 24.8638   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 271.3547                                                                            | 274.1705  | 267.0748  | 251.9688  | 232.9001  | 214.9783  | 203.0054  | 200.1896  | 207.2853  | 222.3914  | 241.4600  | 259.3818  | 259.3818  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 37.0699                                                                             | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |           |      |
| -112.5593                                                                           | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 133.0926                                                                            | 130.7588  | 125.9124  | 119.3237  | 115.0461  | 109.0230  | 103.9036  | 110.4630  | 112.7936  | 119.6130  | 127.3133  | 130.7686  | 130.7686  | (72) |
| Total internal gains                                                                |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 493.8486                                                                            | 491.6257  | 475.6710  | 449.7313  | 423.0448  | 397.5596  | 381.1397  | 387.5881  | 401.0269  | 427.1975  | 457.3066  | 480.2240  | 480.2240  | (73) |

#### 6. Solar gains

|             |          |            |          |               |             |          |          |          |          |          |          |          |      |
|-------------|----------|------------|----------|---------------|-------------|----------|----------|----------|----------|----------|----------|----------|------|
| [Jan]       |          |            |          |               |             |          |          |          |          |          |          |          |      |
|             | Area     | Solar flux | g        | Specific data | FF          | Access   | Gains    |          |          |          |          |          |      |
|             | m2       | Table 6a   | W/m2     | or Table 6b   | or Table 6c | factor   | W        |          |          |          |          |          |      |
|             |          |            |          |               |             | Table 6d |          |          |          |          |          |          |      |
| Southeast   | 12.0000  | 36.7938    | 0.3000   |               | 0.8000      | 0.7700   | 73.4346  | (77)     |          |          |          |          |      |
| Southwest   | 13.2000  | 36.7938    | 0.3000   |               | 0.8000      | 0.7700   | 80.7781  | (79)     |          |          |          |          |      |
| Solar gains | 154.2127 | 262.6812   | 359.4119 | 445.3288      | 498.8053    | 495.1982 | 477.4240 | 437.5280 | 389.1671 | 290.3187 | 184.7112 | 131.9739 | (83) |
| Total gains | 648.0612 | 754.3070   | 835.0829 | 895.0600      | 921.8502    | 892.7579 | 858.5636 | 825.1161 | 790.1940 | 717.5162 | 642.0179 | 612.1979 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |         |              |
| Jan                                                                         | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec     |         |              |
| tau                                                                         | 27.2314 | 27.3018 | 27.3725 | 27.7318 | 27.8048 | 28.1757 | 28.1757 | 28.2510 | 28.0262                   | 27.8048 | 27.6592 | 27.5151 |              |
| alpha                                                                       | 2.8154  | 2.8201  | 2.8248  | 2.8488  | 2.8537  | 2.8784  | 2.8784  | 2.8834  | 2.8684                    | 2.8537  | 2.8439  | 2.8343  |              |
| util living area                                                            | 0.9664  | 0.9481  | 0.9187  | 0.8650  | 0.7769  | 0.6424  | 0.5045  | 0.5377  | 0.7225                    | 0.8815  | 0.9494  | 0.9710  | (86)         |
| MIT                                                                         | 18.8796 | 19.1516 | 19.5508 | 20.0446 | 20.4775 | 20.7937 | 20.9252 | 20.9081 | 20.6896                   | 20.1266 | 19.4173 | 18.8310 | (87)         |
| Th 2                                                                        | 20.0666 | 20.0688 | 20.0710 | 20.0820 | 20.0841 | 20.0951 | 20.0951 | 20.0973 | 20.0907                   | 20.0841 | 20.0798 | 20.0754 | (88)         |
| util rest of house                                                          | 0.9616  | 0.9408  | 0.9068  | 0.8441  | 0.7398  | 0.5794  | 0.4166  | 0.4513  | 0.6668                    | 0.8589  | 0.9410  | 0.9668  | (89)         |
| MIT 2                                                                       | 17.2140 | 17.6076 | 18.1825 | 18.8894 | 19.4856 | 19.8983 | 20.0423 | 20.0289 | 19.7747                   | 19.0169 | 18.0028 | 17.1489 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3468  | (91)         |
| MIT                                                                         | 17.7917 | 18.1431 | 18.6571 | 19.2900 | 19.8296 | 20.2088 | 20.3485 | 20.3339 | 20.0920                   | 19.4018 | 18.4934 | 17.7323 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 17.7917 | 18.1431 | 18.6571 | 19.2900 | 19.8296 | 20.2088 | 20.3485 | 20.3339 | 20.0920                   | 19.4018 | 18.4934 | 17.7323 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |           |           |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|-----------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec       |                |
|                      | 0.9452    | 0.9207    | 0.8841    | 0.8228   | 0.7283   | 0.5879   | 0.4423   | 0.4751   | 0.6669   | 0.8386       | 0.9217    | 0.9518    | (94)           |
| Useful gains         | 612.5653  | 694.4920  | 738.2797  | 736.4916 | 671.3852 | 524.8217 | 379.7706 | 392.0170 | 526.9937 | 601.7011     | 591.7440  | 582.7099  | (95)           |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000    | (96)           |
| Heat loss rate W     |           |           |           |          |          |          |          |          |          |              |           |           |                |
| 1511.9322            | 1480.2465 | 1355.3464 | 1143.3401 | 892.2456 | 607.4858 | 405.9944 | 424.9335 | 652.4437 | 966.0195 | 1257.0413    | 1500.8446 | 1500.8446 | (97)           |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000    | (97a)          |
| Space heating kWh    |           |           |           |          |          |          |          |          |          |              |           |           |                |
| 669.1290             | 528.0270  | 459.0976  | 292.9310  | 164.3201 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 271.0529     | 479.0141  | 683.0922  | (98)           |
| Space heating        |           |           |           |          |          |          |          |          |          |              |           |           |                |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |              |           |           | 3546.6640 (98) |
|                      |           |           |           |          |          |          |          |          |          | (98) / (4) = |           |           | 32.2835 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 3546.6640 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 3723.9972 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2240.4680 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2352.4914 (310a) |
| Electricity used for heat distribution                                                  | 60.7649 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |                  |
| mechanical ventilation fans (SFP = 0.5500)                                              | 184.2902 (330a)  |
| Total electricity for the above, kWh/year                                               | 184.2902 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 427.2290 (332)   |
| Total delivered energy for all uses                                                     | 6688.0077 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 6396.3038          | 0.2160                        | 1381.6016 (367)          |
| Electrical energy for heat distribution                                                    | 60.7649            | 0.5190                        | 31.5370 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1413.1386 (373)          |
| Space and water heating                                                                    |                    |                               | 1413.1386 (376)          |
| Pumps and fans                                                                             | 184.2902           | 0.5190                        | 95.6466 (378)            |
| Energy for lighting                                                                        | 427.2290           | 0.5190                        | 221.7318 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1730.5170 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 15.7500 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 15.7500 ZC1 |
| Total Floor Area                                                                | TFA | 109.8600    |
| Assumed number of occupants                                                     | N   | 2.8140      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 14.6367 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.6979 ZC3  |
| Total CO2 emissions                                                             |     | 32.0847 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 32.0847 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 109.8600 (1b)             | x 2.5000 (2b)                   | = 274.6500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 109.8600                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 274.6500 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)    |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)    |
| Number of intermittent fans                                               |                 |                      |                             |                 | 4 * 10 = 40.0000 (7a)   |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1456 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3956 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3363 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4288 | 0.4204 | 0.4120 | 0.3699 | 0.3615 | 0.3195 | 0.3195 | 0.3111 | 0.3363 | 0.3615 | 0.3783 | 0.3951 (22b) |
| Effective ac    | 0.5919 | 0.5884 | 0.5849 | 0.5684 | 0.5653 | 0.5510 | 0.5510 | 0.5484 | 0.5565 | 0.5653 | 0.5716 | 0.5781 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|------------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| TER Opening Type (Uw = 1.40)                                        |                |                | 25.2000                | 1.3258           | 33.4091        |                   | (27)           |                |                |                |                |                     |
| External Wall 1                                                     | 83.0636        | 25.2000        | 57.8636                | 0.1800           | 10.4154        |                   | (29a)          |                |                |                |                |                     |
| External Roof 1                                                     | 103.0300       |                | 103.0300               | 0.1300           | 13.3939        |                   | (30)           |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 186.0936               |                  |                |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26) ... (30) + (32) = | 57.2184          |                |                   | (33)           |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                        |                  |                |                   | 250.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                |                |                        |                  |                |                   | 9.3047 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                        |                  |                | (33) + (36) =     | 66.5231 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                        |                  |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>53.6487 | Feb<br>53.3252 | Mar<br>53.0081         | Apr<br>51.5186   | May<br>51.2399 | Jun<br>49.9426    | Jul<br>49.9426 | Aug<br>49.7024 | Sep<br>50.4423 | Oct<br>51.2399 | Nov<br>51.8037 | Dec<br>52.3931 (38) |
| Heat transfer coeff                                                 | 120.1718       | 119.8483       | 119.5312               | 118.0417         | 117.7631       | 116.4658          | 116.4658       | 116.2255       | 116.9655       | 117.7631       | 118.3268       | 118.9162 (39)       |
| Average = Sum(39)m / 12 =                                           |                |                |                        |                  |                |                   |                |                |                |                |                | 118.0404 (39)       |
| HLP                                                                 | Jan<br>1.0939  | Feb<br>1.0909  | Mar<br>1.0880          | Apr<br>1.0745    | May<br>1.0719  | Jun<br>1.0601     | Jul<br>1.0601  | Aug<br>1.0579  | Sep<br>1.0647  | Oct<br>1.0719  | Nov<br>1.0771  | Dec<br>1.0824 (40)  |
| HLP (average)                                                       |                |                |                        |                  |                |                   |                |                |                |                |                | 1.0745 (40)         |
| Days in month                                                       | 31             | 28             | 31                     | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |          |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |                    |          | 2.8140 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |                    |          | 101.0321 (43)  |
| Daily hot water use                                         | 111.1353 | 107.0940 | 103.0527 | 99.0115  | 94.9702  | 90.9289  | 90.9289 | 94.9702  | 99.0115  | 103.0527           | 107.0940 | 111.1353 (44)  |
| Energy conte                                                | 164.8104 | 144.1443 | 148.7440 | 129.6786 | 124.4297 | 107.3734 | 99.4972 | 114.1745 | 115.5381 | 134.6485           | 146.9794 | 159.6101 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          | Total = Sum(45)m = |          | 1589.6283 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 24.7216  | 21.6216  | 22.3116  | 19.4518  | 18.6645  | 16.1060  | 14.9246 | 17.1262  | 17.3307  | 20.1973            | 22.0469  | 23.9415 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |          |         |          |          |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325  | 22.5798  | 23.3325            | 22.5798  | 23.3325 (56)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 211.4053 | 186.2300 | 195.3389 | 174.7704 | 171.0246 | 152.4652 | 146.0921 | 160.7694 | 160.6300 | 181.2434 | 192.0712 | 206.2050 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 211.4053 | 186.2300 | 195.3389 | 174.7704 | 171.0246 | 152.4652 | 146.0921 | 160.7694 | 160.6300 | 181.2434 | 192.0712 | 206.2050 (64) |
| Heat gains from water heating, kWh/month                        | 92.0754  | 81.5965  | 86.7333  | 79.1916  | 78.6488  | 71.7751  | 70.3587  | 75.2389  | 74.4899  | 82.0466  | 84.9441  | 90.3463 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 24.1915   | 21.4867   | 17.4741   | 13.2290   | 9.8889    | 8.3486    | 9.0209    | 11.7258   | 15.7383   | 19.9834   | 23.3236   | 24.8638 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 271.3547  | 274.1705  | 267.0748  | 251.9688  | 232.9001  | 214.9783  | 203.0054  | 200.1896  | 207.2853  | 222.3914  | 241.4600  | 259.3818 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 (71) |
| Water heating gains (Table 5)                                                       | 123.7573  | 121.4234  | 116.5770  | 109.9883  | 105.7108  | 99.6877   | 94.5682   | 101.1276  | 103.4582  | 110.2776  | 117.9780  | 121.4332 (72)  |
| Total internal gains                                                                | 487.5132  | 485.2904  | 469.3357  | 443.3959  | 416.7095  | 391.2243  | 374.8043  | 381.2527  | 394.6916  | 420.8621  | 450.9713  | 473.8886 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |  | Gains<br>W    |
|-------------|----------|----------|-----------|------------|--------------------------------|-----------|-----------------------------------|-----------|------------------------------------|----------|------------------------------|--|---------------|
| Southeast   |          |          |           | 12.0000    | 36.7938                        |           | 0.6300                            |           | 0.7000                             |          | 0.7700                       |  | 134.9361 (77) |
| Southwest   |          |          |           | 13.2000    | 36.7938                        |           | 0.6300                            |           | 0.7000                             |          | 0.7700                       |  | 148.4297 (79) |
| Solar gains | 283.3658 | 482.6768 | 660.4194  | 818.2916   | 916.5548                       | 909.9268  | 877.2665                          | 803.9578  | 715.0945                           | 533.4606 | 339.4069                     |  | 242.5021 (83) |
| Total gains | 770.8790 | 967.9671 | 1129.7550 | 1261.6875  | 1333.2643                      | 1301.1510 | 1252.0708                         | 1185.2105 | 1109.7861                          | 954.3227 | 790.3781                     |  | 716.3906 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 63.4855 | 63.6568 | 63.8257 | 64.6311 | 64.7840 | 65.5057 | 65.5057 | 65.6411 | 65.2258 | 64.7840 | 64.4754 | 64.1558      |
| alpha                                                                       | 5.2324  | 5.2438  | 5.2550  | 5.3087  | 5.3189  | 5.3670  | 5.3670  | 5.3761  | 5.3484  | 5.3189  | 5.2984  | 5.2771       |
| util living area                                                            | 0.9959  | 0.9864  | 0.9606  | 0.8887  | 0.7490  | 0.5602  | 0.4073  | 0.4476  | 0.6856  | 0.9262  | 0.9892  | 0.9971 (86)  |
| MIT                                                                         | 19.9297 | 20.1577 | 20.4397 | 20.7339 | 20.9163 | 20.9857 | 20.9978 | 20.9964 | 20.9599 | 20.7044 | 20.2524 | 19.8891 (87) |
| Th 2                                                                        | 20.0058 | 20.0083 | 20.0106 | 20.0217 | 20.0238 | 20.0335 | 20.0335 | 20.0353 | 20.0298 | 20.0238 | 20.0196 | 20.0152 (88) |
| util rest of house                                                          | 0.9945  | 0.9822  | 0.9485  | 0.8577  | 0.6910  | 0.4811  | 0.3189  | 0.3556  | 0.6050  | 0.8979  | 0.9851  | 0.9962 (89)  |
| MIT 2                                                                       | 18.5881 | 18.9198 | 19.3226 | 19.7289 | 19.9489 | 20.0248 | 20.0328 | 20.0340 | 20.0016 | 19.7026 | 19.0677 | 18.5358 (90) |
| Living area fraction                                                        | 19.0534 | 19.3491 | 19.7100 | 20.0774 | 20.2844 | 20.3580 | 20.3675 | 20.3678 | 20.3339 | 20.0500 | 19.4786 | 19.0051 (92) |
| MIT                                                                         | 19.0534 | 19.3491 | 19.7100 | 20.0774 | 20.2844 | 20.3580 | 20.3675 | 20.3678 | 20.3339 | 20.0500 | 19.4786 | 19.0051 (93) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.0534 | 19.3491 | 19.7100 | 20.0774 | 20.2844 | 20.3580 | 20.3675 | 20.3678 | 20.3339 | 20.0500 | 19.4786 | 19.0051 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |           |          |          |          |          |           |           |                           |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|---------------------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                       |
| Useful gains         | 0.9927    | 0.9785    | 0.9441    | 0.8597    | 0.7073    | 0.5082   | 0.3496   | 0.3876   | 0.6314   | 0.8988    | 0.9821    | 0.9948 (94)               |
| Ext temp.            | 765.2682  | 947.2020  | 1066.6457 | 1084.6600 | 943.0344  | 661.2089 | 437.7527 | 459.3895 | 700.7284 | 857.7099  | 776.2385  | 712.6830 (95)             |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000   | 7.1000    | 4.2000 (96)               |
| Month fracti         | 1772.9397 | 1731.7008 | 1579.0072 | 1319.4050 | 1010.9228 | 670.6138 | 438.7792 | 461.1554 | 729.1542 | 1112.8624 | 1464.7187 | 1760.5709 (97)            |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000    | 1.0000    | 1.0000 (97a)              |
| Space heating        | 749.7076  | 527.1832  | 381.1970  | 169.0164  | 50.5089   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.8334  | 495.7058  | 779.6286 (98)             |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           | 3342.7809 (98)            |
|                      |           |           |           |           |           |          |          |          |          |           |           | (98) / (4) = 30.4276 (99) |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 3575.1668 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 749.7076 | 527.1832 | 381.1970 | 169.0164 | 50.5089  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.8334 | 495.7058 | 779.6286 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 801.8263 | 563.8323 | 407.6973 | 180.7662 | 54.0203  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 203.0304 | 530.1666 | 833.8274 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 211.4053 | 186.2300 | 195.3389 | 174.7704 | 171.0246 | 152.4652 | 146.0921 | 160.7694 | 160.6300 | 181.2434 | 192.0712 | 206.2050 (64)   |
| Efficiency of water heater                                            | 87.9073  | 87.4395  | 86.5672  | 84.7248  | 82.0107  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.9374  | 87.2335  | 79.8000 (216)   |
| (217)m                                                                | 87.9073  | 87.4395  | 86.5672  | 84.7248  | 82.0107  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.9374  | 87.2335  | 88.0310 (217)   |
| Fuel for water heating, kWh/month                                     | 240.4866 | 212.9816 | 225.6499 | 206.2802 | 208.5393 | 191.0592 | 183.0728 | 201.4654 | 201.2907 | 213.3847 | 220.1805 | 234.2412 (219)  |
| Water heating fuel used                                               | 240.4866 | 212.9816 | 225.6499 | 206.2802 | 208.5393 | 191.0592 | 183.0728 | 201.4654 | 201.2907 | 213.3847 | 220.1805 | 2538.6323 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3575.1668 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 427.2290 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6616.0280 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3575.1668          | 0.2160                        | 772.2360 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2538.6323          | 0.2160                        | 548.3446 (264)           |
| Space and water heating                                                                           |                    |                               | 1320.5806 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 427.2290           | 0.5190                        | 221.7318 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1581.2374 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.0206 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.0183 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.3543 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.0206 * 1.00) + 2.0183 + 0.3543, rounded to 2 d.p. |                    |                               | 14.3900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001274                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.12_2B |                |            |
| Property                           | B_2_13.12_2B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 13.76        | TER            | 14.39      |
| Environmental                      | 88 B                                | % DER<TER     | 4.40         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.30                                | DFEE          | 42.09        | TFEE           | 42.54      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 1.07         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 110 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.39 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 13.76 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)42.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)42.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element             | Average          | Highest          |    |
|---------------------|------------------|------------------|----|
| External wall       | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor<br>(no floor) |                  |                  |    |
| Roof                | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings            | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.44   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South East: | 12.00 m <sup>2</sup> , No overhang |
| Windows facing South West: | 13.20 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 109.8600 (1b)             | x 2.5000 (2b)                   | = 274.6500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 109.8600                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 274.6500 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    | secondary | other   |        |        | total                       | m3 per hour          |               |  |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|-----------|---------|--------|--------|-----------------------------|----------------------|---------------|--|
|                                                                                              |        |        |        |        | heating |           | heating |        |        |                             |                      |               |  |
| Number of chimneys                                                                           |        |        |        |        | 0       | +         | 0       | +      | 0      | =                           | 0 * 40 =             | 0.0000 (6a)   |  |
| Number of open flues                                                                         |        |        |        |        | 0       | +         | 0       | +      | 0      | =                           | 0 * 20 =             | 0.0000 (6b)   |  |
| Number of intermittent fans                                                                  |        |        |        |        |         |           |         |        |        |                             | 0 * 10 =             | 0.0000 (7a)   |  |
| Number of passive vents                                                                      |        |        |        |        |         |           |         |        |        |                             | 0 * 10 =             | 0.0000 (7b)   |  |
| Number of flueless gas fires                                                                 |        |        |        |        |         |           |         |        |        |                             | 0 * 40 =             | 0.0000 (7c)   |  |
|                                                                                              |        |        |        |        |         |           |         |        |        |                             | Air changes per hour |               |  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                    |        |        |        |        |         |           |         |        |        | 0.0000 / (5) =              |                      | 0.0000 (8)    |  |
| Pressure test                                                                                |        |        |        |        |         |           |         |        |        | Yes                         |                      |               |  |
| Measured/design AP50                                                                         |        |        |        |        |         |           |         |        |        |                             |                      | 3.0000        |  |
| Infiltration rate                                                                            |        |        |        |        |         |           |         |        |        |                             |                      | 0.1500 (18)   |  |
| Number of sides sheltered                                                                    |        |        |        |        |         |           |         |        |        |                             |                      | 2 (19)        |  |
| Shelter factor                                                                               |        |        |        |        |         |           |         |        |        | (20) = 1 - [0.075 x (19)] = |                      | 0.8500 (20)   |  |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |           |         |        |        | (21) = (18) x (20) =        |                      | 0.1275 (21)   |  |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul     | Aug    | Sep    | Oct                         | Nov                  | Dec           |  |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000    | 3.8000  | 3.7000 | 4.0000 | 4.3000                      | 4.5000               | 4.7000 (22)   |  |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500    | 0.9500  | 0.9250 | 1.0000 | 1.0750                      | 1.1250               | 1.1750 (22a)  |  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371  | 0.1211    | 0.1211  | 0.1179 | 0.1275 | 0.1371                      | 0.1434               | 0.1498 (22b)  |  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |           |         |        |        |                             |                      |               |  |
| If mechanical ventilation:                                                                   |        |        |        |        |         |           |         |        |        |                             |                      | 0.5000 (23a)  |  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |           |         |        |        |                             |                      | 77.3500 (23c) |  |
| Effective ac                                                                                 | 0.2758 | 0.2726 | 0.2694 | 0.2535 | 0.2503  | 0.2344    | 0.2344  | 0.2312 | 0.2408 | 0.2503                      | 0.2567               | 0.2631 (25)   |  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|------------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Opening Type 1 (Uw = 1.00)                                          |                |                | 25.2000                | 0.9615           | 24.2308        |                   |                | (27)           |                |                |                |                     |
| External Wall 1                                                     | 83.0636        | 25.2000        | 57.8636                | 0.1600           | 9.2582         |                   |                | (29a)          |                |                |                |                     |
| External Roof 1                                                     | 103.0300       |                | 103.0300               | 0.1600           | 16.4848        |                   |                | (30)           |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 186.0936               |                  |                |                   |                | (31)           |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26) ... (30) + (32) = |                  | 49.9737        |                   |                | (33)           |                |                |                |                     |
| Party Floor 1                                                       |                |                | 109.8600               |                  |                |                   |                | (32d)          |                |                |                |                     |
| Party Ceilings 1                                                    |                |                | 6.8400                 |                  |                |                   |                | (32b)          |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                        |                  |                |                   |                | 100.0000 (35)  |                |                |                |                     |
| Thermal bridges (Default value 0.150 * total exposed area)          |                |                |                        |                  |                |                   |                | 27.9140 (36)   |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                        |                  |                | (33) + (36) =     |                | 77.8878 (37)   |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                        |                  |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>24.9981 | Feb<br>24.7092 | Mar<br>24.4203         | Apr<br>22.9758   | May<br>22.6869 | Jun<br>21.2425    | Jul<br>21.2425 | Aug<br>20.9536 | Sep<br>21.8203 | Oct<br>22.6869 | Nov<br>23.2647 | Dec<br>23.8425 (38) |
| Heat transfer coeff                                                 | 102.8859       | 102.5970       | 102.3081               | 100.8636         | 100.5747       | 99.1302           | 99.1302        | 98.8413        | 99.7080        | 100.5747       | 101.1525       | 101.7303 (39)       |
| Average = Sum(39)m / 12 =                                           |                |                |                        |                  |                |                   |                |                |                |                |                | 100.7914 (39)       |
| HLP                                                                 | Jan<br>0.9365  | Feb<br>0.9339  | Mar<br>0.9313          | Apr<br>0.9181    | May<br>0.9155  | Jun<br>0.9023     | Jul<br>0.9023  | Aug<br>0.8997  | Sep<br>0.9076  | Oct<br>0.9155  | Nov<br>0.9207  | Dec<br>0.9260 (40)  |
| HLP (average)                                                       |                |                |                        |                  |                |                   |                |                |                |                |                | 0.9175 (40)         |
| Days in month                                                       | 31             | 28             | 31                     | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |              |             |             |             |             |             |             |                    |              |                   |
|------------------------------------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------|--------------|-------------------|
| Assumed occupancy                        |              |              |              |             |             |             |             |             |             |                    |              | 2.8140 (42)       |
| Average daily hot water use (litres/day) |              |              |              |             |             |             |             |             |             |                    |              | 101.0321 (43)     |
| Daily hot water use                      | Jan 111.1353 | Feb 107.0940 | Mar 103.0527 | Apr 99.0115 | May 94.9702 | Jun 90.9289 | Jul 90.9289 | Aug 94.9702 | Sep 99.0115 | Oct 103.0527       | Nov 107.0940 | Dec 111.1353 (44) |
| Energy conte                             | 164.8104     | 144.1443     | 148.7440     | 129.6786    | 124.4297    | 107.3734    | 99.4972     | 114.1745    | 115.5381    | 134.6485           | 146.9794     | 159.6101 (45)     |
| Energy content (annual)                  |              |              |              |             |             |             |             |             |             | Total = Sum(45)m = |              | 1589.6283 (45)    |
| Distribution loss (46)m = 0.15 x (45)m   |              |              |              |             |             |             |             |             |             |                    |              |                   |
|                                          | 24.7216      | 21.6216      | 22.3116      | 19.4518     | 18.6645     | 16.1060     | 14.9246     | 17.1262     | 17.3307     | 20.1973            | 22.0469      | 23.9415 (46)      |
| Water storage loss:                      |              |              |              |             |             |             |             |             |             |                    |              |                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                                                                  |         |         |         |         |         |         |         |         |         |         |         |         |                |
|------------------------------------------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------------|
| Store volume                                                                                                     |         |         |         |         |         |         |         |         |         |         |         |         | 110.0000 (47)  |
| b) If manufacturer declared loss factor is not known :                                                           |         |         |         |         |         |         |         |         |         |         |         |         |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)                                                       |         |         |         |         |         |         |         |         |         |         |         |         | 0.0152 (51)    |
| Volume factor from Table 2a                                                                                      |         |         |         |         |         |         |         |         |         |         |         |         | 1.0294 (52)    |
| Temperature factor from Table 2b                                                                                 |         |         |         |         |         |         |         |         |         |         |         |         | 0.6000 (53)    |
| Enter (49) or (54) in (55)                                                                                       |         |         |         |         |         |         |         |         |         |         |         |         | 1.0327 (55)    |
| Total storage loss                                                                                               |         |         |         |         |         |         |         |         |         |         |         |         |                |
| 32.0144 28.9162 32.0144 30.9817 32.0144 30.9817 32.0144 32.0144 30.9817 32.0144 30.9817 32.0144 32.0144 (56)     |         |         |         |         |         |         |         |         |         |         |         |         |                |
| If cylinder contains dedicated solar storage                                                                     |         |         |         |         |         |         |         |         |         |         |         |         |                |
| 32.0144 28.9162 32.0144 30.9817 32.0144 30.9817 32.0144 32.0144 30.9817 32.0144 30.9817 32.0144 32.0144 (57)     |         |         |         |         |         |         |         |         |         |         |         |         |                |
| Primary loss                                                                                                     | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 (59)   |
| Total heat required for water heating calculated for each month                                                  |         |         |         |         |         |         |         |         |         |         |         |         |                |
| 220.0872 194.0717 204.0208 183.1723 179.7065 160.8671 154.7740 169.4513 169.0318 189.9253 200.4731 214.8869 (62) |         |         |         |         |         |         |         |         |         |         |         |         |                |
| Solar input                                                                                                      | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                                                                         |         |         |         |         |         |         |         |         |         |         |         |         | 0.0000 (63)    |
| Output from w/h                                                                                                  |         |         |         |         |         |         |         |         |         |         |         |         |                |
| 220.0872 194.0717 204.0208 183.1723 179.7065 160.8671 154.7740 169.4513 169.0318 189.9253 200.4731 214.8869 (64) |         |         |         |         |         |         |         |         |         |         |         |         |                |
| Total per year (kWh/year) = Sum(64)m =                                                                           |         |         |         |         |         |         |         |         |         |         |         |         | 2240.4680 (64) |
| Heat gains from water heating, kWh/month                                                                         |         |         |         |         |         |         |         |         |         |         |         |         |                |
| 99.0209 87.8699 93.6788 85.9131 85.5943 78.4966 77.3043 82.1845 81.2114 88.9921 91.6656 97.2918 (65)             |         |         |         |         |         |         |         |         |         |         |         |         |                |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                                                              |          |          |          |          |          |          |          |          |          |          |          |          |               |
|------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                                                             |          |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                                                                        | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 | 140.6991 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5                                              |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 24.1915 21.4867 17.4741 13.2290 9.8889 8.3486 9.0209 11.7258 15.7383 19.9834 23.3236 24.8638 (67)                            |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5                                          |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 271.3547 274.1705 267.0748 251.9688 232.9001 214.9783 203.0054 200.1896 207.2853 222.3914 241.4600 259.3818 (68)             |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5                                             |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 37.0699 37.0699 37.0699 37.0699 37.0699 37.0699 37.0699 37.0699 37.0699 37.0699 37.0699 37.0699 (69)                         |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Pumps, fans                                                                                                                  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                                                          |          |          |          |          |          |          |          |          |          |          |          |          |               |
| -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 -112.5593 (71) |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Water heating gains (Table 5)                                                                                                |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 133.0926 130.7588 125.9124 119.3237 115.0461 109.0230 103.9036 110.4630 112.7936 119.6130 127.3133 130.7686 (72)             |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Total internal gains                                                                                                         |          |          |          |          |          |          |          |          |          |          |          |          |               |
| 493.8486 491.6257 475.6710 449.7313 423.0448 397.5596 381.1397 387.5881 401.0269 427.1975 457.3066 480.2240 (73)             |          |          |          |          |          |          |          |          |          |          |          |          |               |

#### 6. Solar gains

| [Jan]       |          |          |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |  |
|-------------|----------|----------|-----------|-----------|------------|--------------------------------|-----------------------------------|-----------|------------------------------------|------------------------------|----------|---------------|--|
| Southeast   |          |          |           |           | 12.0000    | 36.7938                        | 0.5000                            |           | 0.8000                             | 0.7700                       |          | 122.3910 (77) |  |
| Southwest   |          |          |           |           | 13.2000    | 36.7938                        | 0.5000                            |           | 0.8000                             | 0.7700                       |          | 134.6301 (79) |  |
|             |          |          |           |           |            |                                |                                   |           |                                    |                              |          |               |  |
| Solar gains | 257.0211 | 437.8020 | 599.0198  | 742.2146  | 831.3422   | 825.3304                       | 795.7066                          | 729.2134  | 648.6118                           | 483.8645                     | 307.8521 | 219.9565 (83) |  |
| Total gains | 750.8697 | 929.4278 | 1074.6909 | 1191.9459 | 1254.3871  | 1222.8901                      | 1176.8462                         | 1116.8015 | 1049.6387                          | 911.0620                     | 765.1587 | 700.1805 (84) |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 29.6607 | 29.7442 | 29.8282 | 30.2554 | 30.3423 | 30.7844 | 30.7844 | 30.8744 | 30.6060 | 30.3423 | 30.1690 | 29.9976      |
| alpha                                                                       | 2.9774  | 2.9829  | 2.9885  | 3.0170  | 3.0228  | 3.0523  | 3.0523  | 3.0583  | 3.0404  | 3.0228  | 3.0113  | 2.9998       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9503  | 0.9125  | 0.8547  | 0.7599  | 0.6329  | 0.4826  | 0.3591  | 0.3912  | 0.5791  | 0.8007  | 0.9201  | 0.9582 (86)  |
| MIT                                                                         | 19.2357 | 19.5871 | 20.0059 | 20.4435 | 20.7497 | 20.9212 | 20.9760 | 20.9684 | 20.8577 | 20.4397 | 19.7599 | 19.1697 (87) |
| Th 2                                                                        | 20.1366 | 20.1388 | 20.1410 | 20.1521 | 20.1544 | 20.1655 | 20.1655 | 20.1678 | 20.1611 | 20.1544 | 20.1499 | 20.1455 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9437  | 0.9017  | 0.8373  | 0.7324  | 0.5926  | 0.4284  | 0.2950  | 0.3256  | 0.5247  | 0.7711  | 0.9084  | 0.9526 (89)  |
| MIT 2                                                                       | 17.7683 | 18.2711 | 18.8634 | 19.4736 | 19.8771 | 20.0931 | 20.1490 | 20.1450 | 20.0216 | 19.4844 | 18.5328 | 17.6791 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.2772 | 18.7275 | 19.2596 | 19.8099 | 20.1797 | 20.3803 | 20.4358 | 20.4306 | 20.3116 | 19.8157 | 18.9583 | 18.1960 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.2772 | 18.7275 | 19.2596 | 19.8099 | 20.1797 | 20.3803 | 20.4358 | 20.4306 | 20.3116 | 19.8157 | 18.9583 | 18.1960 (93) |

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | 0.9253    | 0.8801    | 0.8168    | 0.7203    | 0.5939   | 0.4427   | 0.3161   | 0.3468   | 0.5349   | 0.7578       | 0.8880    | 0.9358 (94)    |
| Useful gains         | 694.8072  | 817.9631  | 877.8542  | 858.5578  | 744.9454 | 541.4328 | 371.9747 | 387.2615 | 561.4100 | 690.4403     | 679.4914  | 655.2269 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000 (96)    |
| Heat loss rate W     |           |           |           |           |          |          |          |          |          |              |           |                |
|                      | 1438.0569 | 1418.6590 | 1305.4123 | 1100.4157 | 852.8477 | 573.0051 | 380.2434 | 398.3855 | 619.3444 | 926.8649     | 1199.5019 | 1423.8219 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating kWh    |           |           |           |           |          |          |          |          |          |              |           |                |
|                      | 552.9778  | 403.6676  | 318.1032  | 174.1377  | 80.2793  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 175.8999     | 374.4076  | 571.8347 (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 2651.3077 (98) |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |              |           | 24.1335 (99)   |
|                      |           |           |           |           |          |          |          |          |          | (98) / (4) = |           |                |

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8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 2651.3077 | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 2783.8731 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 2240.4680 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2352.4914 | (310a) |
| Electricity used for heat distribution                                                  | 51.3636   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5500)              |           |        |
| mechanical ventilation fans (SFP = 0.5500)                                              | 184.2902  | (330a) |
| Total electricity for the above, kWh/year                                               | 184.2902  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 427.2290  | (332)  |
| Total delivered energy for all uses                                                     | 5747.8837 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 5406.6995          | 0.2160                        | 1167.8471 (367)          |
| Electrical energy for heat distribution                                                    | 51.3636            | 0.5190                        | 26.6577 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1194.5048 (373)          |
| Space and water heating                                                                    |                    |                               | 1194.5048 (376)          |
| Pumps and fans                                                                             | 184.2902           | 0.5190                        | 95.6466 (378)            |
| Energy for lighting                                                                        | 427.2290           | 0.5190                        | 221.7318 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1511.8832 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 13.7600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |          |     |
|---------------------------------------------------------------------------------|-----|----------|-----|
| DER                                                                             |     | 13.7600  | ZC1 |
| Total Floor Area                                                                | TFA | 109.8600 |     |
| Assumed number of occupants                                                     | N   | 2.8140   |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190   |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 14.6367  | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.6979   | ZC3 |
| Total CO2 emissions                                                             |     | 30.0947  | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000   | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000   | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000   | ZC7 |
| Net CO2 emissions                                                               |     | 30.0947  | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 109.8600 (1b)             | x 2.5000 (2b)                   | = 274.6500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 109.8600                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 274.6500 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | +                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 4 * 10 =        | 40.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1456 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3956 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3363 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4288 | 0.4204 | 0.4120 | 0.3699 | 0.3615 | 0.3195 | 0.3195 | 0.3111 | 0.3363 | 0.3615 | 0.3783 | 0.3951 (22b) |
| Effective ac    | 0.5919 | 0.5884 | 0.5849 | 0.5684 | 0.5653 | 0.5510 | 0.5510 | 0.5484 | 0.5565 | 0.5653 | 0.5716 | 0.5781 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|------------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| TER Opening Type (Uw = 1.40)                                        |                |                | 25.2000                | 1.3258           | 33.4091        |                   | (27)           |                |                |                |                |                     |
| External Wall 1                                                     | 83.0636        | 25.2000        | 57.8636                | 0.1800           | 10.4154        |                   | (29a)          |                |                |                |                |                     |
| External Roof 1                                                     | 103.0300       |                | 103.0300               | 0.1300           | 13.3939        |                   | (30)           |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 186.0936               |                  |                |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26) ... (30) + (32) = |                  | 57.2184        |                   | (33)           |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                        |                  |                |                   | 250.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                |                |                        |                  |                |                   | 9.3047 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                        |                  |                | (33) + (36) =     | 66.5231 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                        |                  |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>53.6487 | Feb<br>53.3252 | Mar<br>53.0081         | Apr<br>51.5186   | May<br>51.2399 | Jun<br>49.9426    | Jul<br>49.9426 | Aug<br>49.7024 | Sep<br>50.4423 | Oct<br>51.2399 | Nov<br>51.8037 | Dec<br>52.3931 (38) |
| Heat transfer coeff                                                 | 120.1718       | 119.8483       | 119.5312               | 118.0417         | 117.7631       | 116.4658          | 116.4658       | 116.2255       | 116.9655       | 117.7631       | 118.3268       | 118.9162 (39)       |
| Average = Sum(39)m / 12 =                                           |                |                |                        |                  |                |                   |                |                |                |                |                | 118.0404 (39)       |
| HLP                                                                 | Jan<br>1.0939  | Feb<br>1.0909  | Mar<br>1.0880          | Apr<br>1.0745    | May<br>1.0719  | Jun<br>1.0601     | Jul<br>1.0601  | Aug<br>1.0579  | Sep<br>1.0647  | Oct<br>1.0719  | Nov<br>1.0771  | Dec<br>1.0824 (40)  |
| HLP (average)                                                       |                |                |                        |                  |                |                   |                |                |                |                |                | 1.0745 (40)         |
| Days in month                                                       | 31             | 28             | 31                     | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |          |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |                    |          | 2.8140 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |                    |          | 101.0321 (43)  |
| Daily hot water use                                         | 111.1353 | 107.0940 | 103.0527 | 99.0115  | 94.9702  | 90.9289  | 90.9289 | 94.9702  | 99.0115  | 103.0527           | 107.0940 | 111.1353 (44)  |
| Energy conte                                                | 164.8104 | 144.1443 | 148.7440 | 129.6786 | 124.4297 | 107.3734 | 99.4972 | 114.1745 | 115.5381 | 134.6485           | 146.9794 | 159.6101 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          | Total = Sum(45)m = |          | 1589.6283 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 24.7216  | 21.6216  | 22.3116  | 19.4518  | 18.6645  | 16.1060  | 14.9246 | 17.1262  | 17.3307  | 20.1973            | 22.0469  | 23.9415 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |          |         |          |          |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325  | 22.5798  | 23.3325            | 22.5798  | 23.3325 (56)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 211.4053 | 186.2300 | 195.3389 | 174.7704 | 171.0246 | 152.4652 | 146.0921 | 160.7694 | 160.6300 | 181.2434 | 192.0712 | 206.2050 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 211.4053 | 186.2300 | 195.3389 | 174.7704 | 171.0246 | 152.4652 | 146.0921 | 160.7694 | 160.6300 | 181.2434 | 192.0712 | 206.2050 (64) |
| Heat gains from water heating, kWh/month                        | 92.0754  | 81.5965  | 86.7333  | 79.1916  | 78.6488  | 71.7751  | 70.3587  | 75.2389  | 74.4899  | 82.0466  | 84.9441  | 90.3463 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| (66)m                                                                               | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | 140.6991  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 24.1915   | 21.4867   | 17.4741   | 13.2290   | 9.8889    | 8.3486    | 9.0209    | 11.7258   | 15.7383   | 19.9834   | 23.3236   | 24.8638   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 271.3547  | 274.1705  | 267.0748  | 251.9688  | 232.9001  | 214.9783  | 203.0054  | 200.1896  | 207.2853  | 222.3914  | 241.4600  | 259.3818  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | 37.0699   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | -112.5593 | (71) |
| Water heating gains (Table 5)                                                       | 123.7573  | 121.4234  | 116.5770  | 109.9883  | 105.7108  | 99.6877   | 94.5682   | 101.1276  | 103.4582  | 110.2776  | 117.9780  | 121.4332  | (72) |
| Total internal gains                                                                | 487.5132  | 485.2904  | 469.3357  | 443.3959  | 416.7095  | 391.2243  | 374.8043  | 381.2527  | 394.6916  | 420.8621  | 450.9713  | 473.8886  | (73) |

#### 6. Solar gains

| [Jan]       |          |          |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |           | Access<br>factor<br>Table 6d | Gains<br>W    |               |
|-------------|----------|----------|-----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|-----------|------------------------------|---------------|---------------|
| Southeast   |          |          |           |           | 12.0000    | 36.7938                        | 0.6300                            | 0.7000                             |           | 0.7700                       | 134.9361 (77) |               |
| Southwest   |          |          |           |           | 13.2000    | 36.7938                        | 0.6300                            | 0.7000                             |           | 0.7700                       | 148.4297 (79) |               |
| Solar gains | 283.3658 | 482.6768 | 660.4194  | 818.2916  | 916.5548   | 909.9268                       | 877.2665                          | 803.9578                           | 715.0945  | 533.4606                     | 339.4069      | 242.5021 (83) |
| Total gains | 770.8790 | 967.9671 | 1129.7550 | 1261.6875 | 1333.2643  | 1301.1510                      | 1252.0708                         | 1185.2105                          | 1109.7861 | 954.3227                     | 790.3781      | 716.3906 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |              | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |              |
| tau                                                                         | 63.4855 | 63.6568 | 63.8257 | 64.6311 | 64.7840 | 65.5057 | 65.5057 | 65.6411 | 65.2258                   | 64.7840 | 64.4754 | 64.1558      |              |
| alpha                                                                       | 5.2324  | 5.2438  | 5.2550  | 5.3087  | 5.3189  | 5.3670  | 5.3670  | 5.3761  | 5.3484                    | 5.3189  | 5.2984  | 5.2771       |              |
| util living area                                                            | 0.9959  | 0.9864  | 0.9606  | 0.8887  | 0.7490  | 0.5602  | 0.4073  | 0.4476  | 0.6856                    | 0.9262  | 0.9892  | 0.9971 (86)  |              |
| MIT                                                                         | 19.9297 | 20.1577 | 20.4397 | 20.7339 | 20.9163 | 20.9857 | 20.9978 | 20.9964 | 20.9599                   | 20.7044 | 20.2524 | 19.8891 (87) |              |
| Th 2                                                                        | 20.0058 | 20.0083 | 20.0106 | 20.0217 | 20.0238 | 20.0335 | 20.0335 | 20.0353 | 20.0298                   | 20.0238 | 20.0196 | 20.0152 (88) |              |
| util rest of house                                                          | 0.9945  | 0.9822  | 0.9485  | 0.8577  | 0.6910  | 0.4811  | 0.3189  | 0.3556  | 0.6050                    | 0.8979  | 0.9851  | 0.9962 (89)  |              |
| MIT 2                                                                       | 18.5881 | 18.9198 | 19.3226 | 19.7289 | 19.9489 | 20.0248 | 20.0328 | 20.0340 | 20.0016                   | 19.7026 | 19.0677 | 18.5358 (90) |              |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3468 (91)  |              |
| MIT                                                                         | 19.0534 | 19.3491 | 19.7100 | 20.0774 | 20.2844 | 20.3580 | 20.3675 | 20.3678 | 20.3339                   | 20.0500 | 19.4786 | 19.0051 (92) |              |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |              |
| adjusted MIT                                                                | 19.0534 | 19.3491 | 19.7100 | 20.0774 | 20.2844 | 20.3580 | 20.3675 | 20.3678 | 20.3339                   | 20.0500 | 19.4786 | 19.0051 (93) |              |

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                       |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|---------------------------|
| Utilisation          | 0.9927    | 0.9785    | 0.9441    | 0.8597    | 0.7073    | 0.5082   | 0.3496   | 0.3876   | 0.6314   | 0.8988    | 0.9821    | 0.9948 (94)               |
| Useful gains         | 765.2682  | 947.2020  | 1066.6457 | 1084.6600 | 943.0344  | 661.2089 | 437.7527 | 459.3895 | 700.7284 | 857.7099  | 776.2385  | 712.6830 (95)             |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000   | 7.1000    | 4.2000 (96)               |
| Heat loss rate W     | 1772.9397 | 1731.7008 | 1579.0072 | 1319.4050 | 1010.9228 | 670.6138 | 438.7792 | 461.1554 | 729.1542 | 1112.8624 | 1464.7187 | 1760.5709 (97)            |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000    | 1.0000    | 1.0000 (97a)              |
| Space heating kWh    | 749.7076  | 527.1832  | 381.1970  | 169.0164  | 50.5089   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.8334  | 495.7058  | 779.6286 (98)             |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           | 3342.7809 (98)            |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           | (98) / (4) = 30.4276 (99) |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 3575.1668 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 749.7076 | 527.1832 | 381.1970 | 169.0164 | 50.5089  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.8334 | 495.7058 | 779.6286 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 801.8263 | 563.8323 | 407.6973 | 180.7662 | 54.0203  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 203.0304 | 530.1666 | 833.8274 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 211.4053 | 186.2300 | 195.3389 | 174.7704 | 171.0246 | 152.4652 | 146.0921 | 160.7694 | 160.6300 | 181.2434 | 192.0712 | 206.2050 (64)   |
| Efficiency of water heater (217)m                                     | 87.9073  | 87.4395  | 86.5672  | 84.7248  | 82.0107  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.9374  | 87.2335  | 79.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 240.4866 | 212.9816 | 225.6499 | 206.2802 | 208.5393 | 191.0592 | 183.0728 | 201.4654 | 201.2907 | 213.3847 | 220.1805 | 234.2412 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2538.6323 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3575.1668 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 427.2290 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6616.0280 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3575.1668          | 0.2160                        | 772.2360 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2538.6323          | 0.2160                        | 548.3446 (264)           |
| Space and water heating                                                                           |                    |                               | 1320.5806 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 427.2290           | 0.5190                        | 221.7318 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1581.2374 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.0206 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.0183 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.3543 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.0206 * 1.00) + 2.0183 + 0.3543, rounded to 2 d.p. |                    |                               | 14.3900 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001302                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.13_1B |                |            |
| Property                           | B_2_13.13_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 12.19        | TER            | 13.24      |
| Environmental                      | 91 B                                | % DER<TER     | 7.94         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.75                                | DFEE          | 24.79        | TFEE           | 20.98      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -18.20       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 67 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.24 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.19 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)21.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)24.8 kWh/m<sup>2</sup>/yrFail  
Excess energy =3.8 kWh/m<sup>2</sup>/yr (18.1%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |      |    |
|--------------------------------------|------|----|
| Continuous supply and extract system |      |    |
| Specific fan power:                  | 0.42 |    |
| Maximum                              | 1.5  | OK |
| MVHR efficiency:                     | 91%  |    |
| Minimum:                             | 70%  | OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 11.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.4800 (1b)              | x 2.5000 (2b)                   | = 168.7000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.7000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| Opening Type 1 (Uw = 1.40)                                     |                         |                            | 11.4000                   | 1.3258                        | 15.1136      |                                | (27)                       |
| External Wall 1                                                | 25.9363                 | 11.4000                    | 14.5363                   | 0.1600                        | 2.3258       |                                | (29a)                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 25.9363                   |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 17.4394      |                                | (33)                       |
| Party Floor 1                                                  |                         |                            | 67.4800                   |                               |              |                                | (32d)                      |
| Party Ceilings 1                                               |                         |                            | 67.4800                   |                               |              |                                | (32b)                      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 100.0000 (35)              |
| Thermal bridges (Default value 0.150 * total exposed area)     |                         |                            |                           |                               |              |                                | 3.8904 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 21.3299 (37) |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 14.5562 | 14.3944 | 14.2326 | 13.4237 | 13.2619 | 12.4529 | 12.4529 | 12.2911 | 12.7765 | 13.2619 | 13.5855 | 13.9091 (38) |
| Heat transfer coeff                                                 | 35.8861 | 35.7243 | 35.5625 | 34.7536 | 34.5918 | 33.7828 | 33.7828 | 33.6210 | 34.1064 | 34.5918 | 34.9154 | 35.2389 (39) |
| Average = Sum(39)m / 12 =                                           |         |         |         |         |         |         |         |         |         |         |         | 34.7131 (39) |
| HLP                                                                 | 0.5318  | 0.5294  | 0.5270  | 0.5150  | 0.5126  | 0.5006  | 0.5006  | 0.4982  | 0.5054  | 0.5126  | 0.5174  | 0.5222 (40)  |
| HLP (average)                                                       |         |         |         |         |         |         |         |         |         |         |         | 0.5144 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |                      |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------------------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |                      |          |          |          |          |         |         |         |         |          |          | 2.1834 (42)                       |
| Average daily hot water use (litres/day) |                      |          |          |          |          |         |         |         |         |          |          | 86.0563 (43)                      |
|                                          | Jan                  | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Daily hot water use                      | 94.6620              | 91.2197  | 87.7775  | 84.3352  | 80.8930  | 77.4507 | 77.4507 | 80.8930 | 84.3352 | 87.7775  | 91.2197  | 94.6620 (44)                      |
| Energy conte                             | 140.3810             | 122.7781 | 126.6960 | 110.4566 | 105.9858 | 91.4577 | 84.7490 | 97.2507 | 98.4122 | 114.6899 | 125.1930 | 135.9515 (45)                     |
| Energy content (annual)                  |                      |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1354.0013 (45) |
| Distribution loss                        | (46)m = 0.15 x (45)m |          |          |          |          |         |         |         |         |          |          |                                   |
|                                          | 21.0571              | 18.4167  | 19.0044  | 16.5685  | 15.8979  | 13.7186 | 12.7123 | 14.5876 | 14.7618 | 17.2035  | 18.7789  | 20.3927 (46)                      |
| Water storage loss:                      |                      |          |          |          |          |         |         |         |         |          |          |                                   |
| Store volume                             |                      |          |          |          |          |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|----------|------------|----------|----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                               |          |            |          | 0.0152 (51)                            |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                               |          |            |          | 1.0294 (52)                            |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                               |          |            |          | 0.6000 (53)                            |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                               |          |            |          | 1.0327 (55)                            |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817  | 32.0144    | 30.9817  | 32.0144 (56)                           |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817  | 32.0144    | 30.9817  | 32.0144 (57)                           |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120  | 23.2624    | 22.5120  | 23.2624 (59)                           |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 195.6578 | 172.7055 | 181.9728 | 163.9503 | 161.2626 | 144.9513 | 140.0258 | 152.5275                      | 151.9058 | 169.9667   | 178.6867 | 191.2283 (62)                          |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000   | 0.0000     | 0.0000   | 0.0000 (63)                            |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = |          | Sum(63)m = |          | 0.0000 (63)                            |                |
| Output from w/h                                                 | 195.6578 | 172.7055 | 181.9728 | 163.9503 | 161.2626 | 144.9513 | 140.0258 | 152.5275                      | 151.9058 | 169.9667   | 178.6867 | 191.2283 (64)                          |                |
|                                                                 |          |          |          |          |          |          |          |                               |          |            |          | Total per year (kWh/year) = Sum(64)m = | 2004.8411 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 90.8981  | 80.7657  | 86.3479  | 79.5218  | 79.4617  | 73.2046  | 72.4005  | 76.5573                       | 75.5170  | 82.3558    | 84.4216  | 89.4253 (65)                           |                |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 487.0153  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 511.3661  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 2004.8411 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2105.0832 | (310a) |
| Electricity used for heat distribution                                                  | 26.1645   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 108.0524  | (330a) |
| Total electricity for the above, kWh/year                                               | 108.0524  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 304.6159  | (332)  |
| Total delivered energy for all uses                                                     | 3029.1175 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2754.1571          | 0.2160                        | 594.8979 (367)           |
| Electrical energy for heat distribution                                                    | 26.1645            | 0.5190                        | 13.5794 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 608.4773 (373)           |
| Space and water heating                                                                    |                    |                               | 608.4773 (376)           |
| Pumps and fans                                                                             | 108.0524           | 0.5190                        | 56.0792 (378)            |
| Energy for lighting                                                                        | 304.6159           | 0.5190                        | 158.0957 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 822.6522 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.1900 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 12.1900 | ZC1 |
| Total Floor Area                                                                | TFA | 67.4800 |     |
| Assumed number of occupants                                                     | N   | 2.1834  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.8031 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5400  | ZC3 |
| Total CO2 emissions                                                             |     | 31.5331 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 31.5331 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.4800 (1b)              | x 2.5000 (2b)                   | = 168.7000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.7000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Air changes per hour                                                      |                 |                      |                             |                 |                         |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1186 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3686 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.2856 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3642 | 0.3570 | 0.3499 | 0.3142 | 0.3071 | 0.2713 | 0.2713 | 0.2642 | 0.2856 | 0.3071 | 0.3213 | 0.3356 (22b) |
| Effective ac    | 0.5663 | 0.5637 | 0.5612 | 0.5494 | 0.5471 | 0.5368 | 0.5368 | 0.5349 | 0.5408 | 0.5471 | 0.5516 | 0.5563 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 11.4000                   | 1.3258                        | 15.1136      |                                | (27)          |
| External Wall 1                                                     | 25.9363                 | 11.4000                    | 14.5363                   | 0.1800                        | 2.6165       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 25.9363                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 17.7302      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.2968 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 19.0270 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 31.5272                 | 31.3838                    | 31.2433                   | 30.5833                       | 30.4598      | 29.8850                        | 29.8850       |
| Heat transfer coeff                                                 | 50.5542                 | 50.4108                    | 50.2703                   | 49.6103                       | 49.4868      | 48.9120                        | 48.9120       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 48.8056                        | 49.1334       |
|                                                                     |                         |                            |                           |                               |              | 49.4868                        | 49.7366       |
|                                                                     |                         |                            |                           |                               |              | 49.9978                        | 49.6097 (39)  |
| HLP                                                                 | 0.7492                  | 0.7470                     | 0.7450                    | 0.7352                        | 0.7334       | 0.7248                         | 0.7248        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.7233                         | 0.7281        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 30            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.1834 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.0563 (43)   |
| Daily hot water use                                         | 94.6620  | 91.2197  | 87.7775  | 84.3352  | 80.8930  | 77.4507 | 77.4507 | 80.8930 | 84.3352 | 87.7775            | 91.2197  | 94.6620 (44)   |
| Energy conte                                                | 140.3810 | 122.7781 | 126.6960 | 110.4566 | 105.9858 | 91.4577 | 84.7490 | 97.2507 | 98.4122 | 114.6899           | 125.1930 | 135.9515 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1354.0013 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.0571  | 18.4167  | 19.0044  | 16.5685  | 15.8979  | 13.7186 | 12.7123 | 14.5876 | 14.7618 | 17.2035            | 18.7789  | 20.3927 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 186.9759 | 164.8638 | 173.2909 | 155.5485 | 152.5807 | 136.5495 | 131.3439 | 143.8456                      | 143.5040    | 161.2848 | 170.2848 | 182.5464 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 186.9759 | 164.8638 | 173.2909 | 155.5485 | 152.5807 | 136.5495 | 131.3439 | 143.8456                      | 143.5040    | 161.2848 | 170.2848 | 182.5464 (64)  |
|                                                                 | 83.9526  | 74.4923  | 79.4023  | 72.8003  | 72.5162  | 66.4831  | 65.4550  | 69.6118                       | 68.7955     | 75.4103  | 77.7001  | 82.4798 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1902.6187 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.6137  | 15.6443  | 12.7228  | 9.6320   | 7.2000   | 6.0786   | 6.5681   | 8.5375   | 11.4590  | 14.5498  | 16.9818  | 18.1032  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 191.3456 | 193.3311 | 188.3276 | 177.6756 | 164.2293 | 151.5917 | 143.1491 | 141.1635 | 146.1671 | 156.8191 | 170.2653 | 182.9029 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | (71) |
| Water heating gains (Table 5)                                                       | 112.8395 | 110.8516 | 106.7236 | 101.1115 | 97.4680  | 92.3377  | 87.9771  | 93.5642  | 95.5493  | 101.3579 | 107.9169 | 110.8599 | (72) |
| Total internal gains                                                                | 380.5501 | 378.5784 | 366.5253 | 347.1704 | 327.6487 | 308.7594 | 296.4456 | 302.0166 | 311.9267 | 331.4782 | 353.9153 | 370.6174 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |          |      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|----------|------|
| -----       |          |          |          | Southwest  | 11.4000                        | 36.7938                           | 0.6300                             | 0.7000   | 0.7700   |                              | 128.1893 (79) |          |      |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |                              |               |          |      |
| Solar gains | 128.1893 | 218.3538 | 298.7611 | 370.1795   | 414.6319                       | 411.6335                          | 396.8587                           | 363.6952 | 323.4951 | 241.3274                     | 153.5412      | 109.7033 | (83) |
| Total gains | 508.7394 | 596.9322 | 665.2865 | 717.3500   | 742.2806                       | 720.3929                          | 693.3043                           | 665.7117 | 635.4219 | 572.8056                     | 507.4565      | 480.3207 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 92.6949 | 92.9584 | 93.2183 | 94.4584 | 94.6941 | 95.8070 | 95.8070 | 96.0159 | 95.3752                   | 94.6941 | 94.2185 | 93.7264 |              |
| alpha                                                                       | 7.1797  | 7.1972  | 7.2146  | 7.2972  | 7.3129  | 7.3871  | 7.3871  | 7.4011  | 7.3583                    | 7.3129  | 7.2812  | 7.2484  |              |
| util living area                                                            | 0.9894  | 0.9685  | 0.9144  | 0.7886  | 0.6127  | 0.4340  | 0.3104  | 0.3372  | 0.5311                    | 0.8277  | 0.9697  | 0.9925  | (86)         |
| MIT                                                                         | 20.4881 | 20.6493 | 20.8188 | 20.9479 | 20.9919 | 20.9994 | 21.0000 | 20.9999 | 20.9976                   | 20.9390 | 20.7001 | 20.4537 | (87)         |
| Th 2                                                                        | 20.2976 | 20.2995 | 20.3013 | 20.3099 | 20.3115 | 20.3189 | 20.3189 | 20.3203 | 20.3161                   | 20.3115 | 20.3082 | 20.3048 | (88)         |
| util rest of house                                                          | 0.9864  | 0.9605  | 0.8959  | 0.7547  | 0.5698  | 0.3881  | 0.2624  | 0.2874  | 0.4795                    | 0.7903  | 0.9606  | 0.9903  | (89)         |
| MIT 2                                                                       | 19.6227 | 19.8531 | 20.0861 | 20.2555 | 20.3045 | 20.3186 | 20.3189 | 20.3203 | 20.3145                   | 20.2499 | 19.9347 | 19.5790 | (90)         |
| Living area fraction                                                        | 20.0336 | 20.2311 | 20.4340 | 20.5843 | 20.6308 | 20.6419 | 20.6423 | 20.6430 | fLA = Living area / (4) = | 20.5771 | 20.2981 | 19.9943 | (91)         |
| MIT                                                                         | 20.0336 | 20.2311 | 20.4340 | 20.5843 | 20.6308 | 20.6419 | 20.6423 | 20.6430 | 20.6388                   | 20.5771 | 20.2981 | 19.9943 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0336 | 20.2311 | 20.4340 | 20.5843 | 20.6308 | 20.6419 | 20.6423 | 20.6430 | 20.6388                   | 20.5771 | 20.2981 | 19.9943 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |              |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |       |
| Useful gains         | 0.9850   | 0.9597   | 0.8997   | 0.7686   | 0.5899   | 0.4099   | 0.2852   | 0.3110   | 0.5040   | 0.8053   | 0.9605   | 0.9892       | (94)  |
| Ext temp.            | 501.1335 | 572.8601 | 598.5275 | 551.3351 | 437.8715 | 295.2782 | 197.7031 | 207.0565 | 320.2213 | 461.2999 | 487.4025 | 475.1122     | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)  |
| Month fracti         | 795.3991 | 772.8540 | 700.4665 | 579.6606 | 441.9594 | 295.5196 | 197.7164 | 207.0817 | 321.2756 | 493.7328 | 656.4299 | 789.6818     | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a) |
| Space heating        | 218.9336 | 134.3959 | 75.8426  | 20.3944  | 3.0414   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 24.1300  | 121.6997 | 234.0398     | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 832.4774     | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 12.3367      | (99)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 890.3502  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 218.9336 | 134.3959 | 75.8426  | 20.3944  | 3.0414   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 24.1300  | 121.6997 | 234.0398  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 234.1536 | 143.7389 | 81.1150  | 21.8122  | 3.2528   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 25.8075  | 130.1602 | 250.3099  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating requirement                                             | 186.9759 | 164.8638 | 173.2909 | 155.5485 | 152.5807 | 136.5495 | 131.3439 | 143.8456 | 143.5040 | 161.2848 | 170.2848 | 182.5464  | (64)   |
| Efficiency of water heater                                            | 85.2355  | 84.2748  | 82.7795  | 80.9088  | 79.9848  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0471  | 83.9363  | 85.4777   | (216)  |
| (217)m                                                                | 85.2355  | 84.2748  | 82.7795  | 80.9088  | 79.9848  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0471  | 83.9363  | 85.4777   | (217)  |
| Fuel for water heating, kWh/month                                     | 219.3639 | 195.6265 | 209.3404 | 192.2515 | 190.7620 | 171.1147 | 164.5913 | 180.2576 | 179.8296 | 199.0014 | 202.8738 | 213.5602  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2318.5731 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 890.3502  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 311.0632  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3594.9865 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 890.3502           | 0.2160                        | 192.3156 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2318.5731          | 0.2160                        | 500.8118 (264)           |
| Space and water heating                                                                           |                    |                               | 693.1274 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 311.0632           | 0.5190                        | 161.4418 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 893.4942 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 10.2716 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3924 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5768 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (10.2716 * 1.00) + 2.3924 + 0.5768, rounded to 2 d.p. |                    |                               | 13.2400 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001346                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.13_1B |                |            |
| Property                           | B_2_13.13_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 11.26        | TER            | 13.24      |
| Environmental                      | 91 B                                | % DER<TER     | 14.96        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.72                                | DFEE          | 19.50        | TFEE           | 20.98      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 7.03         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 67 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.24 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 11.26 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)21.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)19.5 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 11.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.4800 (1b)              | x 2.5000 (2b)                   | = 168.7000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.7000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m3 per hour               |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| Opening Type 1 (Uw = 1.00)                                     |                         |                            | 11.4000                   | 0.9615                        | 10.9615      |                                | (27)                       |
| External Wall 1                                                | 25.9363                 | 11.4000                    | 14.5363                   | 0.1600                        | 2.3258       |                                | (29a)                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 25.9363                   |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 13.2873      |                                | (33)                       |
| Party Floor 1                                                  |                         |                            | 67.4800                   |                               |              |                                | (32d)                      |
| Party Ceilings 1                                               |                         |                            | 67.4800                   |                               |              |                                | (32b)                      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 100.0000 (35)              |
| Thermal bridges (Default value 0.150 * total exposed area)     |                         |                            |                           |                               |              |                                | 3.8904 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 17.1778 (37) |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 14.5562 | 14.3944 | 14.2326 | 13.4237 | 13.2619 | 12.4529 | 12.4529 | 12.2911 | 12.7765 | 13.2619 | 13.5855 | 13.9091 (38) |
| Heat transfer coeff                                                 | 31.7340 | 31.5722 | 31.4104 | 30.6015 | 30.4397 | 29.6307 | 29.6307 | 29.4689 | 29.9543 | 30.4397 | 30.7633 | 31.0868 (39) |
| Average = Sum(39)m / 12 =                                           |         |         |         |         |         |         |         |         |         |         |         | 30.5610 (39) |
| HLP                                                                 | 0.4703  | 0.4679  | 0.4655  | 0.4535  | 0.4511  | 0.4391  | 0.4391  | 0.4367  | 0.4439  | 0.4511  | 0.4559  | 0.4607 (40)  |
| HLP (average)                                                       |         |         |         |         |         |         |         |         |         |         |         | 0.4529 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |                      |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------------------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |                      |          |          |          |          |         |         |         |         |          |          | 2.1834 (42)                       |
| Average daily hot water use (litres/day) |                      |          |          |          |          |         |         |         |         |          |          | 86.0563 (43)                      |
|                                          | Jan                  | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Daily hot water use                      | 94.6620              | 91.2197  | 87.7775  | 84.3352  | 80.8930  | 77.4507 | 77.4507 | 80.8930 | 84.3352 | 87.7775  | 91.2197  | 94.6620 (44)                      |
| Energy conte                             | 140.3810             | 122.7781 | 126.6960 | 110.4566 | 105.9858 | 91.4577 | 84.7490 | 97.2507 | 98.4122 | 114.6899 | 125.1930 | 135.9515 (45)                     |
| Energy content (annual)                  |                      |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1354.0013 (45) |
| Distribution loss                        | (46)m = 0.15 x (45)m |          |          |          |          |         |         |         |         |          |          |                                   |
|                                          | 21.0571              | 18.4167  | 19.0044  | 16.5685  | 15.8979  | 13.7186 | 12.7123 | 14.5876 | 14.7618 | 17.2035  | 18.7789  | 20.3927 (46)                      |
| Water storage loss:                      |                      |          |          |          |          |         |         |         |         |          |          |                                   |
| Store volume                             |                      |          |          |          |          |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|----------|------------|----------|----------------------------------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                               |          |            |          | 0.0152 (51)                            |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                               |          |            |          | 1.0294 (52)                            |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                               |          |            |          | 0.6000 (53)                            |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                               |          |            |          | 1.0327 (55)                            |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817  | 32.0144    | 30.9817  | 32.0144 (56)                           |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817  | 32.0144    | 30.9817  | 32.0144 (57)                           |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120  | 23.2624    | 22.5120  | 23.2624 (59)                           |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 195.6578 | 172.7055 | 181.9728 | 163.9503 | 161.2626 | 144.9513 | 140.0258 | 152.5275                      | 151.9058 | 169.9667   | 178.6867 | 191.2283 (62)                          |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000   | 0.0000     | 0.0000   | 0.0000 (63)                            |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = |          | Sum(63)m = |          | 0.0000 (63)                            |                |
| Output from w/h                                                 | 195.6578 | 172.7055 | 181.9728 | 163.9503 | 161.2626 | 144.9513 | 140.0258 | 152.5275                      | 151.9058 | 169.9667   | 178.6867 | 191.2283 (64)                          |                |
|                                                                 |          |          |          |          |          |          |          |                               |          |            |          | Total per year (kWh/year) = Sum(64)m = | 2004.8411 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                               |          |            |          |                                        |                |
|                                                                 | 90.8981  | 80.7657  | 86.3479  | 79.5218  | 79.4617  | 73.2046  | 72.4005  | 76.5573                       | 75.5170  | 82.3558    | 84.4216  | 89.4253 (65)                           |                |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.2486  | 15.3201  | 12.4591  | 9.4324   | 7.0508   | 5.9526   | 6.4320   | 8.3605   | 11.2215  | 14.2482  | 16.6298  | 17.7280 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 191.3456 | 193.3311 | 188.3276 | 177.6756 | 164.2293 | 151.5917 | 143.1491 | 141.1635 | 146.1671 | 156.8191 | 170.2653 | 182.9029 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 (71) |
| Water heating gains (Table 5)                                                       | 122.1749 | 120.1870 | 116.0590 | 110.4469 | 106.8034 | 101.6731 | 97.3125  | 102.8996 | 104.8847 | 110.6933 | 117.2522 | 120.1953 (72) |
| Total internal gains                                                                | 386.5204 | 384.5896 | 372.5970 | 353.3062 | 333.8349 | 314.9688 | 302.6449 | 308.1750 | 318.0246 | 337.5120 | 359.8987 | 376.5776 (73) |

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d | Gains<br>W    |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|------------------------------|---------------|----------|---------------|
| -----       | -----    | -----    | -----    | -----      | -----                          | -----                             | -----                              | -----    | -----                        | -----         |          |               |
| Southwest   |          |          |          | 11.4000    | 36.7938                        | 0.5000                            | 0.8000                             |          | 0.7700                       | 116.2715 (79) |          |               |
| -----       | -----    | -----    | -----    | -----      | -----                          | -----                             | -----                              | -----    | -----                        | -----         |          |               |
| Solar gains | 116.2715 | 198.0533 | 270.9852 | 335.7638   | 376.0834                       | 373.3638                          | 359.9625                           | 329.8822 | 293.4196                     | 218.8911      | 139.2664 | 99.5041 (83)  |
| Total gains | 502.7919 | 582.6429 | 643.5822 | 689.0699   | 709.9182                       | 688.3325                          | 662.6074                           | 638.0572 | 611.4442                     | 556.4031      | 499.1651 | 476.0817 (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 59.0674 | 59.3700 | 59.6759 | 61.2534 | 61.5790 | 63.2602 | 63.2602 | 63.6075 | 62.5768 | 61.5790 | 60.9313 | 60.2970      |
| alpha                                                                       | 4.9378  | 4.9580  | 4.9784  | 5.0836  | 5.1053  | 5.2173  | 5.2173  | 5.2405  | 5.1718  | 5.1053  | 5.0621  | 5.0198       |
| util living area                                                            |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.8527  | 0.7708  | 0.6653  | 0.5265  | 0.3966  | 0.2753  | 0.1967  | 0.2124  | 0.3372  | 0.5547  | 0.7644  | 0.8700 (86)  |
| MIT                                                                         | 20.6494 | 20.7947 | 20.9054 | 20.9740 | 20.9945 | 20.9994 | 20.9999 | 20.9999 | 20.9982 | 20.9723 | 20.8396 | 20.6240 (87) |
| Th 2                                                                        | 20.5482 | 20.5504 | 20.5526 | 20.5636 | 20.5659 | 20.5770 | 20.5770 | 20.5792 | 20.5725 | 20.5659 | 20.5614 | 20.5570 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.8419  | 0.7571  | 0.6490  | 0.5090  | 0.3785  | 0.2571  | 0.1778  | 0.1930  | 0.3165  | 0.5337  | 0.7486  | 0.8601 (89)  |
| MIT 2                                                                       | 20.0798 | 20.2811 | 20.4321 | 20.5320 | 20.5597 | 20.5764 | 20.5769 | 20.5791 | 20.5707 | 20.5332 | 20.3549 | 20.0526 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.8419  | 0.7571  | 0.6490  | 0.5090  | 0.3785  | 0.2571  | 0.1778  | 0.1930  | 0.3165  | 0.5337  | 0.7486  | 0.8601 (91)  |
| MIT                                                                         | 20.3503 | 20.5249 | 20.6568 | 20.7419 | 20.7662 | 20.7773 | 20.7778 | 20.7789 | 20.7737 | 20.7417 | 20.5850 | 20.3239 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 20.3503 | 20.5249 | 20.6568 | 20.7419 | 20.7662 | 20.7773 | 20.7778 | 20.7789 | 20.7737 | 20.7417 | 20.5850 | 20.3239 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8369   | 0.7563   | 0.6529   | 0.5162   | 0.3868   | 0.2657   | 0.1868   | 0.2022   | 0.3263   | 0.5423       | 0.7495   | 0.8546 (94)   |
| Useful gains         | 420.7977 | 440.6281 | 420.1705 | 355.6950 | 274.6112 | 182.9023 | 123.7739 | 129.0174 | 199.4912 | 301.7267     | 374.1101 | 406.8548 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 509.3399 | 493.3143 | 444.6718 | 362.3786 | 275.9712 | 183.0363 | 123.7898 | 129.0411 | 199.9064 | 308.7093     | 414.8439 | 501.2412 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 65.8754  | 35.4051  | 18.2290  | 4.8121   | 1.0118   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 5.1951       | 29.3283  | 70.2235 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 230.0803 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 3.4096 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 230.0803  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 241.5843  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 2004.8411 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2105.0832 | (310a) |
| Electricity used for heat distribution                                                  | 23.4667   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 108.0524  | (330a) |
| Total electricity for the above, kWh/year                                               | 108.0524  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 304.6159  | (332)  |
| Total delivered energy for all uses                                                     | 2759.3358 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2470.1763          | 0.2160                        | 533.5581 (367)           |
| Electrical energy for heat distribution                                                    | 23.4667            | 0.5190                        | 12.1792 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 545.7373 (373)           |
| Space and water heating                                                                    |                    |                               | 545.7373 (376)           |
| Pumps and fans                                                                             | 108.0524           | 0.5190                        | 56.0792 (378)            |
| Energy for lighting                                                                        | 304.6159           | 0.5190                        | 158.0957 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 759.9121 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 11.2600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 11.2600 | ZC1 |
| Total Floor Area                                                                | TFA | 67.4800 |     |
| Assumed number of occupants                                                     | N   | 2.1834  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.8031 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5400  | ZC3 |
| Total CO2 emissions                                                             |     | 30.6031 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 30.6031 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.4800 (1b)              | x 2.5000 (2b)                   | = 168.7000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.4800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.7000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Air changes per hour                                                      |                 |                      |                             |                 |                         |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1186 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3686 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.2856 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3642 | 0.3570 | 0.3499 | 0.3142 | 0.3071 | 0.2713 | 0.2713 | 0.2642 | 0.2856 | 0.3071 | 0.3213 | 0.3356 (22b) |
| Effective ac    | 0.5663 | 0.5637 | 0.5612 | 0.5494 | 0.5471 | 0.5368 | 0.5368 | 0.5349 | 0.5408 | 0.5471 | 0.5516 | 0.5563 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 11.4000                   | 1.3258                        | 15.1136      |                                | (27)          |
| External Wall 1                                                     | 25.9363                 | 11.4000                    | 14.5363                   | 0.1800                        | 2.6165       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 25.9363                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 17.7302      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.2968 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 19.0270 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 31.5272                 | 31.3838                    | 31.2433                   | 30.5833                       | 30.4598      | 29.8850                        | 29.8850       |
| Heat transfer coeff                                                 | 50.5542                 | 50.4108                    | 50.2703                   | 49.6103                       | 49.4868      | 48.9120                        | 48.9120       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 48.8056                        | 49.1334       |
|                                                                     |                         |                            |                           |                               |              | 49.4868                        | 49.7366       |
|                                                                     |                         |                            |                           |                               |              | 49.9978                        | 49.6097 (39)  |
| HLP                                                                 | 0.7492                  | 0.7470                     | 0.7450                    | 0.7352                        | 0.7334       | 0.7248                         | 0.7248        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.7233                         | 0.7281        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 30            |
|                                                                     |                         |                            |                           |                               |              | 31                             | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.1834 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.0563 (43)   |
| Daily hot water use                                         | 94.6620  | 91.2197  | 87.7775  | 84.3352  | 80.8930  | 77.4507 | 77.4507 | 80.8930 | 84.3352 | 87.7775            | 91.2197  | 94.6620 (44)   |
| Energy conte                                                | 140.3810 | 122.7781 | 126.6960 | 110.4566 | 105.9858 | 91.4577 | 84.7490 | 97.2507 | 98.4122 | 114.6899           | 125.1930 | 135.9515 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1354.0013 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.0571  | 18.4167  | 19.0044  | 16.5685  | 15.8979  | 13.7186 | 12.7123 | 14.5876 | 14.7618 | 17.2035            | 18.7789  | 20.3927 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 186.9759 | 164.8638 | 173.2909 | 155.5485 | 152.5807 | 136.5495 | 131.3439 | 143.8456                      | 143.5040    | 161.2848 | 170.2848 | 182.5464 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 186.9759 | 164.8638 | 173.2909 | 155.5485 | 152.5807 | 136.5495 | 131.3439 | 143.8456                      | 143.5040    | 161.2848 | 170.2848 | 182.5464 (64)  |
|                                                                 | 83.9526  | 74.4923  | 79.4023  | 72.8003  | 72.5162  | 66.4831  | 65.4550  | 69.6118                       | 68.7955     | 75.4103  | 77.7001  | 82.4798 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1902.6187 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | 109.1712 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.6137  | 15.6443  | 12.7228  | 9.6320   | 7.2000   | 6.0786   | 6.5681   | 8.5375   | 11.4590  | 14.5498  | 16.9818  | 18.1032  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 191.3456 | 193.3311 | 188.3276 | 177.6756 | 164.2293 | 151.5917 | 143.1491 | 141.1635 | 146.1671 | 156.8191 | 170.2653 | 182.9029 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | 33.9171  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | -87.3370 | (71) |
| Water heating gains (Table 5)                                                       | 112.8395 | 110.8516 | 106.7236 | 101.1115 | 97.4680  | 92.3377  | 87.9771  | 93.5642  | 95.5493  | 101.3579 | 107.9169 | 110.8599 | (72) |
| Total internal gains                                                                | 380.5501 | 378.5784 | 366.5253 | 347.1704 | 327.6487 | 308.7594 | 296.4456 | 302.0166 | 311.9267 | 331.4782 | 353.9153 | 370.6174 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area     | Solar flux | g             | FF            |          |          | Access   |          |          | Gains         |
|-------------|----------|----------|----------|----------|------------|---------------|---------------|----------|----------|----------|----------|----------|---------------|
|             |          |          |          | m2       | Table 6a   | Specific data | Specific data |          |          | factor   |          |          | W             |
|             |          |          |          |          | W/m2       | or Table 6b   | or Table 6c   |          |          | Table 6d |          |          |               |
| Southwest   |          |          |          | 11.4000  | 36.7938    | 0.6300        | 0.7000        |          |          | 0.7700   |          |          | 128.1893 (79) |
| Solar gains | 128.1893 | 218.3538 | 298.7611 | 370.1795 | 414.6319   | 411.6335      | 396.8587      | 363.6952 | 323.4951 | 241.3274 | 153.5412 | 109.7033 | (83)          |
| Total gains | 508.7394 | 596.9322 | 665.2865 | 717.3500 | 742.2806   | 720.3929      | 693.3043      | 665.7117 | 635.4219 | 572.8056 | 507.4565 | 480.3207 | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 92.6949 | 92.9584 | 93.2183 | 94.4584 | 94.6941 | 95.8070 | 95.8070 | 96.0159 | 95.3752                   | 94.6941 | 94.2185 | 93.7264 |              |
| alpha                                                                       | 7.1797  | 7.1972  | 7.2146  | 7.2972  | 7.3129  | 7.3871  | 7.3871  | 7.4011  | 7.3583                    | 7.3129  | 7.2812  | 7.2484  |              |
| util living area                                                            | 0.9894  | 0.9685  | 0.9144  | 0.7886  | 0.6127  | 0.4340  | 0.3104  | 0.3372  | 0.5311                    | 0.8277  | 0.9697  | 0.9925  | (86)         |
| MIT                                                                         | 20.4881 | 20.6493 | 20.8188 | 20.9479 | 20.9919 | 20.9994 | 21.0000 | 20.9999 | 20.9976                   | 20.9390 | 20.7001 | 20.4537 | (87)         |
| Th 2                                                                        | 20.2976 | 20.2995 | 20.3013 | 20.3099 | 20.3115 | 20.3189 | 20.3189 | 20.3203 | 20.3161                   | 20.3115 | 20.3082 | 20.3048 | (88)         |
| util rest of house                                                          | 0.9864  | 0.9605  | 0.8959  | 0.7547  | 0.5698  | 0.3881  | 0.2624  | 0.2874  | 0.4795                    | 0.7903  | 0.9606  | 0.9903  | (89)         |
| MIT 2                                                                       | 19.6227 | 19.8531 | 20.0861 | 20.2555 | 20.3045 | 20.3186 | 20.3189 | 20.3203 | 20.3145                   | 20.2499 | 19.9347 | 19.5790 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4748  | (91)         |
| MIT                                                                         | 20.0336 | 20.2311 | 20.4340 | 20.5843 | 20.6308 | 20.6419 | 20.6423 | 20.6430 | 20.6388                   | 20.5771 | 20.2981 | 19.9943 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0336 | 20.2311 | 20.4340 | 20.5843 | 20.6308 | 20.6419 | 20.6423 | 20.6430 | 20.6388                   | 20.5771 | 20.2981 | 19.9943 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |              |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |       |
|                      | 0.9850   | 0.9597   | 0.8997   | 0.7686   | 0.5899   | 0.4099   | 0.2852   | 0.3110   | 0.5040   | 0.8053   | 0.9605   | 0.9892       | (94)  |
| Useful gains         | 501.1335 | 572.8601 | 598.5275 | 551.3351 | 437.8715 | 295.2782 | 197.7031 | 207.0565 | 320.2213 | 461.2999 | 487.4025 | 475.1122     | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)  |
| Heat loss rate W     | 795.3991 | 772.8540 | 700.4665 | 579.6606 | 441.9594 | 295.5196 | 197.7164 | 207.0817 | 321.2756 | 493.7328 | 656.4299 | 789.6818     | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a) |
| Space heating kWh    | 218.9336 | 134.3959 | 75.8426  | 20.3944  | 3.0414   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 24.1300  | 121.6997 | 234.0398     | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 832.4774     | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 12.3367      | (99)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 890.3502  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |        |
| Space heating requirement                                             | 218.9336 | 134.3959 | 75.8426  | 20.3944  | 3.0414   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 24.1300  | 121.6997 | 234.0398  | (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)  |
| Space heating fuel (main heating system)                              | 234.1536 | 143.7389 | 81.1150  | 21.8122  | 3.2528   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 25.8075  | 130.1602 | 250.3099  | (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)  |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Water heating requirement                                             | 186.9759 | 164.8638 | 173.2909 | 155.5485 | 152.5807 | 136.5495 | 131.3439 | 143.8456 | 143.5040 | 161.2848 | 170.2848 | 182.5464  | (64)   |
| Efficiency of water heater                                            | 85.2355  | 84.2748  | 82.7795  | 80.9088  | 79.9848  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0471  | 83.9363  | 85.4777   | (216)  |
| (217)m                                                                | 85.2355  | 84.2748  | 82.7795  | 80.9088  | 79.9848  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0471  | 83.9363  | 85.4777   | (217)  |
| Fuel for water heating, kWh/month                                     | 219.3639 | 195.6265 | 209.3404 | 192.2515 | 190.7620 | 171.1147 | 164.5913 | 180.2576 | 179.8296 | 199.0014 | 202.8738 | 213.5602  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2318.5731 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 890.3502  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |        |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 311.0632  | (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3594.9865 | (238)  |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 890.3502           | 0.2160                        | 192.3156 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2318.5731          | 0.2160                        | 500.8118 (264)           |
| Space and water heating                                                                           |                    |                               | 693.1274 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 311.0632           | 0.5190                        | 161.4418 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 893.4942 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 10.2716 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3924 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5768 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (10.2716 * 1.00) + 2.3924 + 0.5768, rounded to 2 d.p. |                    |                               | 13.2400 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |      |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|------|----------------|------------|
| Property Reference                 | INDEX_001374                        |               |              |      | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.14_1B |      |                |            |
| Property                           | B_2_13.14_1B                        |               |              |      |                |            |
|                                    |                                     |               |              |      |                |            |
| SAP Rating                         | 84 B                                | DER           | 14.16        | TER  | 14.70          |            |
| Environmental                      | 90 B                                | % DER<TER     | 3.65         |      |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.72                                | DFEE          | 30.14        | TFEE | 26.29          |            |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -14.66       |      |                |            |
|                                    |                                     |               |              |      |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              |      | Assessor ID    | Admin      |
| Client                             |                                     |               |              |      |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.70 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.16 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)26.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)30.1 kWh/m<sup>2</sup>/yrFail  
Excess energy =3.8 kWh/m<sup>2</sup>/yr (14.4%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

|                           |      |
|---------------------------|------|
| Secondary heating system: | None |
|---------------------------|------|

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.2400 (1b)              | x 2.5000 (2b)                   | = 140.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.2400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 140.6000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| Opening Type 1 (Uw = 1.40)                                     |                         |                            | 14.4000                   | 1.3258                        | 19.0909      |                                | (27)                       |
| External Wall 1                                                | 28.0438                 | 14.4000                    | 13.6438                   | 0.1600                        | 2.1830       |                                | (29a)                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 28.0438                   |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 21.2739      |                                | (33)                       |
| Party Floor 1                                                  |                         |                            | 56.2400                   |                               |              |                                | (32d)                      |
| Party Ceilings 1                                               |                         |                            | 56.2400                   |                               |              |                                | (32b)                      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 100.0000 (35)              |
| Thermal bridges (Default value 0.150 * total exposed area)     |                         |                            |                           |                               |              |                                | 4.2066 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 25.4805 (37) |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 12.1316 | 11.9968 | 11.8619 | 11.1877 | 11.0529 | 10.3787 | 10.3787 | 10.2438 | 10.6483 | 11.0529 | 11.3226 | 11.5923 (38) |
| Average = Sum(39)m / 12 =                                           | 37.6121 | 37.4773 | 37.3424 | 36.6682 | 36.5334 | 35.8591 | 35.8591 | 35.7243 | 36.1288 | 36.5334 | 36.8030 | 37.0727 (39) |
|                                                                     |         |         |         |         |         |         |         |         |         |         |         | 36.6345 (39) |
| HLP                                                                 | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 0.6688  | 0.6664  | 0.6640  | 0.6520  | 0.6496  | 0.6376  | 0.6376  | 0.6352  | 0.6424  | 0.6496  | 0.6544  | 0.6592 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |         |          |          | 1.8736 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |         |          |          | 78.6977 (43)                      |
| Daily hot water use                      | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Energy conte                             | 86.5675  | 83.4196  | 80.2717  | 77.1238  | 73.9759 | 70.8279 | 70.8279 | 73.9759 | 77.1238 | 80.2717  | 83.4196  | 86.5675 (44)                      |
| Energy content (annual)                  | 128.3771 | 112.2794 | 115.8623 | 101.0116 | 96.9230 | 83.6372 | 77.5021 | 88.9348 | 89.9970 | 104.8828 | 114.4878 | 124.3264 (45)                     |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1238.2216 (45) |
| Water storage loss:                      | 19.2566  | 16.8419  | 17.3793  | 15.1517  | 14.5385 | 12.5456 | 11.6253 | 13.3402 | 13.4996 | 15.7324  | 17.1732  | 18.6490 (46)                      |
| Store volume                             |          |          |          |          |         |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                               |            |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|------------|----------|----------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                               |            |          |          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                               |            |          |          | 0.0152 (51)    |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                               |            |          |          | 1.0294 (52)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                               |            |          |          | 0.6000 (53)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                               |            |          |          | 1.0327 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |                               |            |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817    | 32.0144  | 30.9817  | 32.0144 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                               |            |          |          |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                       | 30.9817    | 32.0144  | 30.9817  | 32.0144 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120    | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                               |            |          |          |                |
|                                                                 | 183.6539 | 162.2069 | 171.1391 | 154.5052 | 152.1998 | 137.1309 | 132.7789 | 144.2116                      | 143.4907   | 160.1596 | 167.9815 | 179.6032 (63)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000     | 0.0000   | 0.0000   | 0.0000 (62)    |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum(63)m = |          |          | 0.0000 (63)    |
| Output from w/h                                                 | 183.6539 | 162.2069 | 171.1391 | 154.5052 | 152.1998 | 137.1309 | 132.7789 | 144.2116                      | 143.4907   | 160.1596 | 167.9815 | 179.6032 (64)  |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum(64)m = |          |          | 1889.0613 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                               |            |          |          |                |
|                                                                 | 86.9068  | 77.2749  | 82.7457  | 76.3813  | 76.4483  | 70.6043  | 69.9909  | 73.7923                       | 72.7189    | 79.0950  | 80.8621  | 85.5600 (65)   |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 634.9962  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 666.7460  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1889.0613 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1983.5144 | (310a) |
| Electricity used for heat distribution                                                  | 26.5026   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 90.0543   | (330a) |
| Total electricity for the above, kWh/year                                               | 90.0543   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 257.2223  | (332)  |
| Total delivered energy for all uses                                                     | 2997.5371 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2789.7478          | 0.2160                        | 602.5855 (367)           |
| Electrical energy for heat distribution                                                    | 26.5026            | 0.5190                        | 13.7549 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 616.3404 (373)           |
| Space and water heating                                                                    |                    |                               | 616.3404 (376)           |
| Pumps and fans                                                                             | 90.0543            | 0.5190                        | 46.7382 (378)            |
| Energy for lighting                                                                        | 257.2223           | 0.5190                        | 133.4984 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 796.5770 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.1600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 14.1600 | ZC1 |
| Total Floor Area                                                                | TFA | 56.2400 |     |
| Assumed number of occupants                                                     | N   | 1.8736  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.2142 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.9155  | ZC3 |
| Total CO2 emissions                                                             |     | 34.2897 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 34.2897 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.2400 (1b)              | x 2.5000 (2b)                   | = 140.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.2400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 140.6000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Air changes per hour                                                      |                 |                      |                             |                 |                         |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1422 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3922 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3040 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3876 | 0.3800 | 0.3724 | 0.3344 | 0.3268 | 0.2888 | 0.2888 | 0.2812 | 0.3040 | 0.3268 | 0.3420 | 0.3572 (22b) |
| Effective ac    | 0.5751 | 0.5722 | 0.5693 | 0.5559 | 0.5534 | 0.5417 | 0.5417 | 0.5395 | 0.5462 | 0.5534 | 0.5585 | 0.5638 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 14.0600                   | 1.3258                        | 18.6402      |                                | (27)          |
| External Wall 1                                                     | 28.0438                 | 14.0600                    | 13.9838                   | 0.1800                        | 2.5171       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 28.0438                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 21.1572      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.4022 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 22.5594 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 26.6841                 | 26.5488                    | 26.4161                   | 25.7931                       | 25.6765      | 25.1338                        | 25.1338       |
| Heat transfer coeff                                                 | 49.2435                 | 49.1082                    | 48.9755                   | 48.3525                       | 48.2359      | 47.6932                        | 47.6932       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 47.5928                        | 47.9023       |
|                                                                     | 48.2359                 | 48.4717                    | 48.7183                   | 48.3519                       | 48.3519      | 48.3519                        | 48.3519       |
| HLP                                                                 | 0.8756                  | 0.8732                     | 0.8708                    | 0.8598                        | 0.8577       | 0.8480                         | 0.8480        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.8462                         | 0.8517        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.8736 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 78.6977 (43)   |
| Daily hot water use                                         | 86.5675  | 83.4196  | 80.2717  | 77.1238  | 73.9759 | 70.8279 | 70.8279 | 73.9759 | 77.1238 | 80.2717            | 83.4196  | 86.5675 (44)   |
| Energy conte                                                | 128.3771 | 112.2794 | 115.8623 | 101.0116 | 96.9230 | 83.6372 | 77.5021 | 88.9348 | 89.9970 | 104.8828           | 114.4878 | 124.3264 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1238.2216 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.2566  | 16.8419  | 17.3793  | 15.1517  | 14.5385 | 12.5456 | 11.6253 | 13.3402 | 13.4996 | 15.7324            | 17.1732  | 18.6490 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 174.9720 | 154.3651 | 162.4572 | 146.1034 | 143.5179 | 128.7290 | 124.0970 | 135.5297                      | 135.0888    | 151.4777 | 159.5797 | 170.9213 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 174.9720 | 154.3651 | 162.4572 | 146.1034 | 143.5179 | 128.7290 | 124.0970 | 135.5297                      | 135.0888    | 151.4777 | 159.5797 | 170.9213 (64)  |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1786.8390 (64) |
|                                                                 | 79.9613  | 71.0015  | 75.8001  | 69.6598  | 69.5028  | 63.8828  | 63.0454  | 66.8468                       | 65.9975     | 72.1495  | 74.1407  | 78.6144 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.5650  | 12.9365  | 10.5207  | 7.9648   | 5.9538   | 5.0264   | 5.4313   | 7.0597   | 9.4756   | 12.0314  | 14.0424  | 14.9698  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 163.3749 | 165.0703 | 160.7981 | 151.7032 | 140.2225 | 129.4323 | 122.2237 | 120.5284 | 124.8006 | 133.8955 | 145.3762 | 156.1664 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | (71) |
| Water heating gains (Table 5)                                                       | 107.4749 | 105.6570 | 101.8819 | 96.7497  | 93.4178  | 88.7262  | 84.7384  | 89.8478  | 91.6632  | 96.9751  | 102.9732 | 105.6646 | (72) |
| Total internal gains                                                                | 339.5186 | 337.7675 | 327.3045 | 310.5216 | 293.6979 | 277.2887 | 266.4972 | 271.5398 | 280.0431 | 297.0058 | 316.4956 | 330.9046 | (73) |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |          |               |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
| Southwest   | 14.0600    |          |          |          | 36.7938                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 158.1001 (79) |
| Solar gains | 158.1001   | 269.3030 | 368.4721 | 456.5548 | 511.3794                       | 507.6814 | 489.4590                          | 448.5574 | 398.9773                           | 297.6372 | 189.3675                     | 135.3007 | (83)          |
| Total gains | 497.6187   | 607.0705 | 695.7766 | 767.0764 | 805.0773                       | 784.9701 | 755.9562                          | 720.0972 | 679.0205                           | 594.6430 | 505.8631                     | 466.2053 | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 79.3111 | 79.5296 | 79.7450 | 80.7726 | 80.9678 | 81.8891 | 81.8891 | 82.0620 | 81.5317                   | 80.9678 | 80.5739 | 80.1661 |              |
| alpha                                                                       | 6.2874  | 6.3020  | 6.3163  | 6.3848  | 6.3979  | 6.4593  | 6.4593  | 6.4708  | 6.4354                    | 6.3979  | 6.3716  | 6.3444  |              |
| util living area                                                            | 0.9828  | 0.9486  | 0.8720  | 0.7256  | 0.5513  | 0.3883  | 0.2775  | 0.3039  | 0.4843                    | 0.7815  | 0.9544  | 0.9877  | (86)         |
| MIT                                                                         | 20.4141 | 20.6223 | 20.8180 | 20.9498 | 20.9916 | 20.9993 | 20.9999 | 20.9999 | 20.9971                   | 20.9349 | 20.6634 | 20.3696 | (87)         |
| Th 2                                                                        | 20.1883 | 20.1903 | 20.1924 | 20.2018 | 20.2036 | 20.2119 | 20.2119 | 20.2134 | 20.2087                   | 20.2036 | 20.2000 | 20.1963 | (88)         |
| util rest of house                                                          | 0.9780  | 0.9364  | 0.8469  | 0.6868  | 0.5061  | 0.3408  | 0.2279  | 0.2520  | 0.4299                    | 0.7377  | 0.9412  | 0.9842  | (89)         |
| MIT 2                                                                       | 19.4270 | 19.7204 | 19.9828 | 20.1511 | 20.1966 | 20.2115 | 20.2119 | 20.2134 | 20.2068                   | 20.1401 | 19.7900 | 19.3698 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5958  | (91)         |
| MIT                                                                         | 20.0152 | 20.2578 | 20.4804 | 20.6270 | 20.6703 | 20.6809 | 20.6814 | 20.6820 | 20.6777                   | 20.6137 | 20.3104 | 19.9655 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0152 | 20.2578 | 20.4804 | 20.6270 | 20.6703 | 20.6809 | 20.6814 | 20.6820 | 20.6777                   | 20.6137 | 20.3104 | 19.9655 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec      |       |
|                      | 0.9768   | 0.9375   | 0.8563   | 0.7078   | 0.5327   | 0.3691   | 0.2575   | 0.2829   | 0.4622   | 0.7609       | 0.9432   | 0.9830   | (94)  |
| Useful gains         | 486.0965 | 569.1243 | 595.7895 | 542.9681 | 428.8837 | 289.7215 | 194.6340 | 203.7512 | 313.8747 | 452.4823     | 477.1542 | 458.2872 | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000   | (96)  |
| Heat loss rate W     | 773.8693 | 754.1941 | 684.6992 | 567.0297 | 432.6900 | 290.0161 | 194.6566 | 203.7926 | 315.0855 | 483.0176     | 640.3312 | 768.0676 | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000   | (97a) |
| Space heating kWh    | 214.1030 | 124.3669 | 66.1488  | 17.3244  | 2.8319   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 22.7183      | 117.4875 | 230.4766 | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 795.4573 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 14.1440  | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)   |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)   |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 850.7564 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                |
| Space heating requirement                                             | 214.1030 | 124.3669 | 66.1488  | 17.3244  | 2.8319   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 22.7183  | 117.4875 | 230.4766  | (98)           |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)          |
| Space heating fuel (main heating system)                              | 228.9871 | 133.0127 | 70.7474  | 18.5287  | 3.0287   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 24.2976  | 125.6551 | 246.4991  | (211)          |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)          |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Water heating requirement                                             | 174.9720 | 154.3651 | 162.4572 | 146.1034 | 143.5179 | 128.7290 | 124.0970 | 135.5297 | 135.0888 | 151.4777 | 159.5797 | 170.9213  | (64)           |
| Efficiency of water heater                                            | 85.3532  | 84.2442  | 82.6268  | 80.8129  | 79.9830  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0498  | 84.0119  | 85.6119   | (216)          |
| (217)m                                                                | 85.3532  | 84.2442  | 82.6268  | 80.8129  | 79.9830  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0498  | 84.0119  | 85.6119   | (217)          |
| Fuel for water heating, kWh/month                                     | 204.9975 | 183.2353 | 196.6157 | 180.7923 | 179.4355 | 161.3146 | 155.5101 | 169.8368 | 169.2843 | 186.8948 | 189.9488 | 199.6465  | (219)          |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2177.5121 | (219)          |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 850.7564  | (211)          |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)          |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)         |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)         |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)          |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 257.2223  | (232)          |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3360.4909 | (238)          |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 850.7564           | 0.2160                        | 183.7634 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2177.5121          | 0.2160                        | 470.3426 (264)           |
| Space and water heating                                                                           |                    |                               | 654.1060 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 257.2223           | 0.5190                        | 133.4984 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 826.5294 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.6306 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3737 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6921 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.6306 * 1.00) + 2.3737 + 0.6921, rounded to 2 d.p. |                    |                               | 14.7000 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001418                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.14_1B |                |            |
| Property                           | B_2_13.14_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 85 B                                | DER           | 12.67        | TER            | 14.70      |
| Environmental                      | 91 B                                | % DER<TER     | 13.79        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.67                                | DFEE          | 22.89        | TFEE           | 26.29      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 12.91        |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.70 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.67 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)26.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)22.9 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.2400 (1b)              | x 2.5000 (2b)                   | = 140.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.2400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 140.6000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|----------------------------|
| Opening Type 1 (Uw = 1.00)                                     |                         |                            | 14.4000                   | 0.9615                        | 13.8462                      |                                | (27)                       |
| External Wall 1                                                | 28.0438                 | 14.4000                    | 13.6438                   | 0.1600                        | 2.1830                       |                                | (29a)                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 28.0438                   |                               |                              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 16.0292 |                                | (33)                       |
| Party Floor 1                                                  |                         |                            | 56.2400                   |                               |                              |                                | (32d)                      |
| Party Ceilings 1                                               |                         |                            | 56.2400                   |                               |                              |                                | (32b)                      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 100.0000 (35)              |
| Thermal bridges (Default value 0.150 * total exposed area)     |                         |                            |                           |                               |                              |                                | 4.2066 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              |                                | (33) + (36) = 20.2357 (37) |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 12.1316 | 11.9968 | 11.8619 | 11.1877 | 11.0529 | 10.3787 | 10.3787 | 10.2438 | 10.6483 | 11.0529 | 11.3226 | 11.5923 (38) |
| Average = Sum(39)m / 12 =                                           | 32.3674 | 32.2325 | 32.0977 | 31.4234 | 31.2886 | 30.6144 | 30.6144 | 30.4795 | 30.8841 | 31.2886 | 31.5583 | 31.8280 (39) |
|                                                                     |         |         |         |         |         |         |         |         |         |         |         | 31.3897 (39) |
| HLP                                                                 | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 0.5755  | 0.5731  | 0.5707  | 0.5587  | 0.5563  | 0.5444  | 0.5444  | 0.5420  | 0.5491  | 0.5563  | 0.5611  | 0.5659 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |         |          |          | 1.8736 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |         |          |          | 78.6977 (43)                      |
| Daily hot water use                      | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Energy conte                             | 86.5675  | 83.4196  | 80.2717  | 77.1238  | 73.9759 | 70.8279 | 70.8279 | 73.9759 | 77.1238 | 80.2717  | 83.4196  | 86.5675 (44)                      |
| Energy content (annual)                  | 128.3771 | 112.2794 | 115.8623 | 101.0116 | 96.9230 | 83.6372 | 77.5021 | 88.9348 | 89.9970 | 104.8828 | 114.4878 | 124.3264 (45)                     |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1238.2216 (45) |
| Water storage loss:                      | 19.2566  | 16.8419  | 17.3793  | 15.1517  | 14.5385 | 12.5456 | 11.6253 | 13.3402 | 13.4996 | 15.7324  | 17.1732  | 18.6490 (46)                      |
| Store volume                             |          |          |          |          |         |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 183.6539 | 162.2069 | 171.1391 | 154.5052 | 152.1998 | 137.1309 | 132.7789 | 144.2116                                 | 143.4907 | 160.1596 | 167.9815 | 179.6032 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 183.6539 | 162.2069 | 171.1391 | 154.5052 | 152.1998 | 137.1309 | 132.7789 | 144.2116                                 | 143.4907 | 160.1596 | 167.9815 | 179.6032 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 1889.0613 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 86.9068  | 77.2749  | 82.7457  | 76.3813  | 76.4483  | 70.6043  | 69.9909  | 73.7923                                  | 72.7189  | 79.0950  | 80.8621  | 85.5600 (65)  |                |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.5650  | 12.9365  | 10.5207  | 7.9648   | 5.9538   | 5.0264   | 5.4313   | 7.0597   | 9.4756   | 12.0314  | 14.0424  | 14.9698 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 163.3749 | 165.0703 | 160.7981 | 151.7032 | 140.2225 | 129.4323 | 122.2237 | 120.5284 | 124.8006 | 133.8955 | 145.3762 | 156.1664 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 (71) |
| Water heating gains (Table 5)                                                       | 116.8102 | 114.9923 | 111.2173 | 106.0851 | 102.7531 | 98.0615  | 94.0738  | 99.1832  | 100.9985 | 106.3105 | 112.3085 | 114.9999 (72) |
| Total internal gains                                                                | 345.8540 | 344.1029 | 333.6399 | 316.8570 | 300.0333 | 283.6241 | 272.8326 | 277.8752 | 286.3785 | 303.3412 | 322.8310 | 337.2400 (73) |

| [Jan]       |          |          |          | Area     | Solar flux | g             |          | FF            | Access   |          | Gains         |               |
|-------------|----------|----------|----------|----------|------------|---------------|----------|---------------|----------|----------|---------------|---------------|
|             |          |          |          | m2       | Table 6a   | Specific data |          | Specific data | factor   |          | W             |               |
|             |          |          |          |          | W/m2       | or Table 6b   |          | or Table 6c   | Table 6d |          |               |               |
| Southwest   |          |          |          | 14.4000  | 36.7938    | 0.5000        |          | 0.8000        | 0.7700   |          | 146.8692 (79) |               |
| Solar gains | 146.8692 | 250.1726 | 342.2970 | 424.1226 | 475.0527   | 471.6174      | 454.6895 | 416.6934      | 370.6353 | 276.4940 | 175.9155      | 125.6894 (83) |
| Total gains | 492.7232 | 594.2755 | 675.9369 | 740.9796 | 775.0860   | 755.2415      | 727.5221 | 694.5685      | 657.0138 | 579.8352 | 498.7464      | 462.9294 (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |                           |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| Utilisation factor for gains for living area, nll,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |                           |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec          |
| tau                                                                         | 48.2654 | 48.4673 | 48.6709 | 49.7152 | 49.9294 | 51.0290 | 51.0290 | 51.2548 | 50.5834 | 49.9294                   | 49.5027 | 49.0833      |
| alpha                                                                       | 4.2177  | 4.2312  | 4.2447  | 4.3143  | 4.3286  | 4.4019  | 4.4019  | 4.4170  | 4.3722  | 4.3286                    | 4.3002  | 4.2722       |
| util living area                                                            | 0.8438  | 0.7504  | 0.6373  | 0.4987  | 0.3720  | 0.2589  | 0.1851  | 0.2017  | 0.3227  | 0.5400                    | 0.7559  | 0.8638 (86)  |
| MIT                                                                         | 20.5052 | 20.7102 | 20.8624 | 20.9572 | 20.9895 | 20.9985 | 20.9997 | 20.9996 | 20.9958 | 20.9509                   | 20.7540 | 20.4630 (87) |
| Th 2                                                                        | 20.4521 | 20.4542 | 20.4564 | 20.4673 | 20.4695 | 20.4803 | 20.4803 | 20.4825 | 20.4760 | 20.4695                   | 20.4651 | 20.4608 (88) |
| util rest of house                                                          | 0.8315  | 0.7346  | 0.6187  | 0.4787  | 0.3514  | 0.2380  | 0.1632  | 0.1791  | 0.2986  | 0.5157                    | 0.7379  | 0.8526 (89)  |
| MIT 2                                                                       | 19.7951 | 20.0774 | 20.2829 | 20.4160 | 20.4578 | 20.4789 | 20.4801 | 20.4822 | 20.4718 | 20.4122                   | 20.1508 | 19.7441 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.5958 (91)  |
| MIT                                                                         | 20.2182 | 20.4545 | 20.6282 | 20.7384 | 20.7746 | 20.7885 | 20.7897 | 20.7905 | 20.7840 | 20.7332                   | 20.5102 | 20.1724 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | 0.0000       |
| adjusted MIT                                                                | 20.2182 | 20.4545 | 20.6282 | 20.7384 | 20.7746 | 20.7885 | 20.7897 | 20.7905 | 20.7840 | 20.7332                   | 20.5102 | 20.1724 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | 0.8260   | 0.7346   | 0.6246   | 0.4889   | 0.3633   | 0.2504   | 0.1762   | 0.1926   | 0.3128   | 0.5279       | 0.7394   | 0.8462 (94)    |
| Useful gains         | 406.9657 | 436.5492 | 422.2052 | 362.2787 | 281.5913 | 189.1335 | 128.2154 | 133.7456 | 205.5311 | 306.0790     | 368.7836 | 391.7403 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 515.2291 | 501.3591 | 453.4820 | 372.0048 | 283.9316 | 189.4561 | 128.2662 | 133.8206 | 206.4295 | 317.0524     | 423.2021 | 508.3701 (97a) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 80.5480  | 43.5523  | 23.2699  | 7.0028   | 1.7412   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 8.1642       | 39.1813  | 86.7726 (98)   |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 290.2322 (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 5.1606 (99)    |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |                |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 290.2322  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 304.7438  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1889.0613 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 1983.5144 | (310a) |
| Electricity used for heat distribution                                                  | 22.8826   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |           |        |
| mechanical ventilation fans (SFP = 0.5250)                                              | 90.0543   | (330a) |
| Total electricity for the above, kWh/year                                               | 90.0543   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 257.2223  | (332)  |
| Total delivered energy for all uses                                                     | 2635.5349 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2408.6929          | 0.2160                        | 520.2777 (367)           |
| Electrical energy for heat distribution                                                    | 22.8826            | 0.5190                        | 11.8761 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 532.1537 (373)           |
| Space and water heating                                                                    |                    |                               | 532.1537 (376)           |
| Pumps and fans                                                                             | 90.0543            | 0.5190                        | 46.7382 (378)            |
| Energy for lighting                                                                        | 257.2223           | 0.5190                        | 133.4984 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 712.3903 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.6700 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 12.6700 | ZC1 |
| Total Floor Area                                                                | TFA | 56.2400 |     |
| Assumed number of occupants                                                     | N   | 1.8736  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.2142 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.9155  | ZC3 |
| Total CO2 emissions                                                             |     | 32.7997 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 32.7997 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 56.2400 (1b)              | x 2.5000 (2b)                   | = 140.6000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 56.2400                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 140.6000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Air changes per hour                                                      |                 |                      |                             |                 |                         |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 20.0000 / (5) = | 0.1422 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3922 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3040 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3876 | 0.3800 | 0.3724 | 0.3344 | 0.3268 | 0.2888 | 0.2888 | 0.2812 | 0.3040 | 0.3268 | 0.3420 | 0.3572 (22b) |
| Effective ac    | 0.5751 | 0.5722 | 0.5693 | 0.5559 | 0.5534 | 0.5417 | 0.5417 | 0.5395 | 0.5462 | 0.5534 | 0.5585 | 0.5638 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|---------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opening Type (Uw = 1.40)                                        |                         |                            | 14.0600                   | 1.3258                        | 18.6402      |                                | (27)          |
| External Wall 1                                                     | 28.0438                 | 14.0600                    | 13.9838                   | 0.1800                        | 2.5171       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )         |                         |                            | 28.0438                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                                 |                         |                            | (26)...(30) + (32) =      |                               | 21.1572      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K      |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area)     |                         |                            |                           |                               |              |                                | 1.4022 (36)   |
| Total fabric heat loss                                              |                         |                            |                           |                               |              | (33) + (36) =                  | 22.5594 (37)  |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                         |                            |                           |                               |              |                                |               |
| (38)m                                                               | 26.6841                 | 26.5488                    | 26.4161                   | 25.7931                       | 25.6765      | 25.1338                        | 25.1338       |
| Heat transfer coeff                                                 | 49.2435                 | 49.1082                    | 48.9755                   | 48.3525                       | 48.2359      | 47.6932                        | 47.6932       |
| Average = Sum(39)m / 12 =                                           |                         |                            |                           |                               |              | 47.5928                        | 47.9023       |
|                                                                     | 48.2359                 | 48.4717                    | 48.7183                   | 48.3519                       | 48.3519      | 48.3519                        | 48.3519       |
| HLP                                                                 | 0.8756                  | 0.8732                     | 0.8708                    | 0.8598                        | 0.8577       | 0.8480                         | 0.8480        |
| HLP (average)                                                       |                         |                            |                           |                               |              | 0.8462                         | 0.8517        |
| Days in month                                                       | 31                      | 28                         | 31                        | 30                            | 31           | 30                             | 31            |
|                                                                     |                         |                            |                           |                               |              | 30                             | 31            |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.8736 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 78.6977 (43)   |
| Daily hot water use                                         | 86.5675  | 83.4196  | 80.2717  | 77.1238  | 73.9759 | 70.8279 | 70.8279 | 73.9759 | 77.1238 | 80.2717            | 83.4196  | 86.5675 (44)   |
| Energy conte                                                | 128.3771 | 112.2794 | 115.8623 | 101.0116 | 96.9230 | 83.6372 | 77.5021 | 88.9348 | 89.9970 | 104.8828           | 114.4878 | 124.3264 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1238.2216 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.2566  | 16.8419  | 17.3793  | 15.1517  | 14.5385 | 12.5456 | 11.6253 | 13.3402 | 13.4996 | 15.7324            | 17.1732  | 18.6490 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 174.9720 | 154.3651 | 162.4572 | 146.1034 | 143.5179 | 128.7290 | 124.0970 | 135.5297                      | 135.0888    | 151.4777 | 159.5797 | 170.9213 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 174.9720 | 154.3651 | 162.4572 | 146.1034 | 143.5179 | 128.7290 | 124.0970 | 135.5297                      | 135.0888    | 151.4777 | 159.5797 | 170.9213 (64)  |
|                                                                 | 79.9613  | 71.0015  | 75.8001  | 69.6598  | 69.5028  | 63.8828  | 63.0454  | 66.8468                       | 65.9975     | 72.1495  | 74.1407  | 78.6144 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1786.8390 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | 93.6794  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.5650  | 12.9365  | 10.5207  | 7.9648   | 5.9538   | 5.0264   | 5.4313   | 7.0597   | 9.4756   | 12.0314  | 14.0424  | 14.9698  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 163.3749 | 165.0703 | 160.7981 | 151.7032 | 140.2225 | 129.4323 | 122.2237 | 120.5284 | 124.8006 | 133.8955 | 145.3762 | 156.1664 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | 32.3679  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | -74.9435 | (71) |
| Water heating gains (Table 5)                                                       | 107.4749 | 105.6570 | 101.8819 | 96.7497  | 93.4178  | 88.7262  | 84.7384  | 89.8478  | 91.6632  | 96.9751  | 102.9732 | 105.6646 | (72) |
| Total internal gains                                                                | 339.5186 | 337.7675 | 327.3045 | 310.5216 | 293.6979 | 277.2887 | 266.4972 | 271.5398 | 280.0431 | 297.0058 | 316.4956 | 330.9046 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |      |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|------|
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |      |
| Southwest   |          |          |          |          | 14.0600    | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 158.1001 (79) |      |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |      |
| Solar gains | 158.1001 | 269.3030 | 368.4721 | 456.5548 | 511.3794   | 507.6814                       | 489.4590                          | 448.5574                           | 398.9773 | 297.6372 | 189.3675                     | 135.3007      | (83) |
| Total gains | 497.6187 | 607.0705 | 695.7766 | 767.0764 | 805.0773   | 784.9701                       | 755.9562                          | 720.0972                           | 679.0205 | 594.6430 | 505.8631                     | 466.2053      | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 79.3111 | 79.5296 | 79.7450 | 80.7726 | 80.9678 | 81.8891 | 81.8891 | 82.0620 | 81.5317                   | 80.9678 | 80.5739 | 80.1661 |              |
| alpha                                                                       | 6.2874  | 6.3020  | 6.3163  | 6.3848  | 6.3979  | 6.4593  | 6.4593  | 6.4708  | 6.4354                    | 6.3979  | 6.3716  | 6.3444  |              |
| util living area                                                            | 0.9828  | 0.9486  | 0.8720  | 0.7256  | 0.5513  | 0.3883  | 0.2775  | 0.3039  | 0.4843                    | 0.7815  | 0.9544  | 0.9877  | (86)         |
| MIT                                                                         | 20.4141 | 20.6223 | 20.8180 | 20.9498 | 20.9916 | 20.9993 | 20.9999 | 20.9999 | 20.9971                   | 20.9349 | 20.6634 | 20.3696 | (87)         |
| Th 2                                                                        | 20.1883 | 20.1903 | 20.1924 | 20.2018 | 20.2036 | 20.2119 | 20.2119 | 20.2134 | 20.2087                   | 20.2036 | 20.2000 | 20.1963 | (88)         |
| util rest of house                                                          | 0.9780  | 0.9364  | 0.8469  | 0.6868  | 0.5061  | 0.3408  | 0.2279  | 0.2520  | 0.4299                    | 0.7377  | 0.9412  | 0.9842  | (89)         |
| MIT 2                                                                       | 19.4270 | 19.7204 | 19.9828 | 20.1511 | 20.1966 | 20.2115 | 20.2119 | 20.2134 | 20.2068                   | 20.1401 | 19.7900 | 19.3698 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5958  | (91)         |
| MIT                                                                         | 20.0152 | 20.2578 | 20.4804 | 20.6270 | 20.6703 | 20.6809 | 20.6814 | 20.6820 | 20.6777                   | 20.6137 | 20.3104 | 19.9655 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0152 | 20.2578 | 20.4804 | 20.6270 | 20.6703 | 20.6809 | 20.6814 | 20.6820 | 20.6777                   | 20.6137 | 20.3104 | 19.9655 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec      |       |
|                      | 0.9768   | 0.9375   | 0.8563   | 0.7078   | 0.5327   | 0.3691   | 0.2575   | 0.2829   | 0.4622   | 0.7609       | 0.9432   | 0.9830   | (94)  |
| Useful gains         | 486.0965 | 569.1243 | 595.7895 | 542.9681 | 428.8837 | 289.7215 | 194.6340 | 203.7512 | 313.8747 | 452.4823     | 477.1542 | 458.2872 | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000   | (96)  |
| Heat loss rate W     | 773.8693 | 754.1941 | 684.6992 | 567.0297 | 432.6900 | 290.0161 | 194.6566 | 203.7926 | 315.0855 | 483.0176     | 640.3312 | 768.0676 | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000   | (97a) |
| Space heating kWh    | 214.1030 | 124.3669 | 66.1488  | 17.3244  | 2.8319   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 22.7183      | 117.4875 | 230.4766 | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 795.4573 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 14.1440  | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)   |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)   |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 850.7564 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                |
| Space heating requirement                                             | 214.1030 | 124.3669 | 66.1488  | 17.3244  | 2.8319   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 22.7183  | 117.4875 | 230.4766  | (98)           |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)          |
| Space heating fuel (main heating system)                              | 228.9871 | 133.0127 | 70.7474  | 18.5287  | 3.0287   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 24.2976  | 125.6551 | 246.4991  | (211)          |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)          |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Water heating requirement                                             | 174.9720 | 154.3651 | 162.4572 | 146.1034 | 143.5179 | 128.7290 | 124.0970 | 135.5297 | 135.0888 | 151.4777 | 159.5797 | 170.9213  | (64)           |
| Efficiency of water heater                                            | 85.3532  | 84.2442  | 82.6268  | 80.8129  | 79.9830  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0498  | 84.0119  | 85.6119   | (216)          |
| (217)m                                                                | 85.3532  | 84.2442  | 82.6268  | 80.8129  | 79.9830  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 81.0498  | 84.0119  | 85.6119   | (217)          |
| Fuel for water heating, kWh/month                                     | 204.9975 | 183.2353 | 196.6157 | 180.7923 | 179.4355 | 161.3146 | 155.5101 | 169.8368 | 169.2843 | 186.8948 | 189.9488 | 199.6465  | (219)          |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2177.5121 | (219)          |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 850.7564  | (211)          |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)          |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)         |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)         |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)          |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 257.2223  | (232)          |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3360.4909 | (238)          |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 850.7564           | 0.2160                        | 183.7634 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2177.5121          | 0.2160                        | 470.3426 (264)           |
| Space and water heating                                                                           |                    |                               | 654.1060 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 257.2223           | 0.5190                        | 133.4984 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 826.5294 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.6306 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3737 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6921 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.6306 * 1.00) + 2.3737 + 0.6921, rounded to 2 d.p. |                    |                               | 14.7000 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001446                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.15_1B |                |            |
| Property                           | B_2_13.15_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 12.30        | TER            | 13.12      |
| Environmental                      | 91 B                                | % DER<TER     | 6.23         |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.75                                | DFEE          | 25.41        | TFEE           | 20.99      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | -21.06       |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.12 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.30 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)21.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)25.4 kWh/m<sup>2</sup>/yrFail  
Excess energy =4.4 kWh/m<sup>2</sup>/yr (21.0%)

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                           |                          |   |
|---------------------------|--------------------------|---|
| Main heating system:      | Community heating scheme | - |
| Secondary heating system: | None                     |   |

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

|                     |             |
|---------------------|-------------|
| Hot water controls: | No cylinder |
|---------------------|-------------|

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                    |      |
|-----------------------------------|------------------------------------|------|
| Overheating risk (Thames Valley): | High                               | Fail |
| Based on:                         |                                    |      |
| Overshading:                      | Average                            |      |
| Windows facing South West:        | 14.40 m <sup>2</sup> , No overhang |      |
| Air change rate:                  | 2.00 ach                           |      |
| Blinds/curtains:                  | None                               |      |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
|------------------|--------------------------------------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.5600 (1b)              | x 2.5000 (2b)                   | = 168.9000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.5600                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.9000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m3 per hour               |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|---------------|------------------|--------------|-------------------|---------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.40)                                          |             |                | 14.4000       | 1.3258           | 19.0909      |                   | (27)          |         |         |         |         |              |
| External Wall 1                                                     | 21.2155     | 14.4000        | 6.8155        | 0.1600           | 1.0905       |                   | (29a)         |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 21.2155       |                  |              |                   | (31)          |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...       | (30) + (32) =    | 20.1814      |                   | (33)          |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 67.5600       |                  |              |                   | (32d)         |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 67.5600       |                  |              |                   | (32b)         |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                  |              |                   | 100.0000 (35) |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |               |                  |              |                   | 3.1823 (36)   |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |               |                  |              | (33) + (36) =     | 23.3637 (37)  |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |               |                  |              |                   |               |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 14.5735     | 14.4115        | 14.2495       | 13.4396          | 13.2776      | 12.4677           | 12.4677       | 12.3057 | 12.7916 | 13.2776 | 13.6016 | 13.9255 (38) |
| Heat transfer coeff                                                 | 37.9372     | 37.7752        | 37.6132       | 36.8033          | 36.6413      | 35.8314           | 35.8314       | 35.6694 | 36.1554 | 36.6413 | 36.9653 | 37.2893 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |               |                  |              |                   |               |         |         |         |         | 36.7628 (39) |
|                                                                     | Jan         | Feb            | Mar           | Apr              | May          | Jun               | Jul           | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.5615      | 0.5591         | 0.5567        | 0.5447           | 0.5424       | 0.5304            | 0.5304        | 0.5280  | 0.5352  | 0.5424  | 0.5471  | 0.5519 (40)  |
| HLP (average)                                                       |             |                |               |                  |              |                   |               |         |         |         |         | 0.5442 (40)  |
| Days in month                                                       | 31          | 28             | 31            | 30               | 31           | 30                | 31            | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |                      |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------------------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |                      |          |          |          |          |         |         |         |         |          |          | 2.1855 (42)                       |
| Average daily hot water use (litres/day) |                      |          |          |          |          |         |         |         |         |          |          | 86.1047 (43)                      |
|                                          | Jan                  | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Daily hot water use                      | 94.7152              | 91.2710  | 87.8268  | 84.3826  | 80.9384  | 77.4942 | 77.4942 | 80.9384 | 84.3826 | 87.8268  | 91.2710  | 94.7152 (44)                      |
| Energy conte                             | 140.4599             | 122.8471 | 126.7672 | 110.5187 | 106.0453 | 91.5091 | 84.7966 | 97.3053 | 98.4675 | 114.7543 | 125.2633 | 136.0279 (45)                     |
| Energy content (annual)                  |                      |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1354.7621 (45) |
| Distribution loss                        | (46)m = 0.15 x (45)m |          |          |          |          |         |         |         |         |          |          |                                   |
|                                          | 21.0690              | 18.4271  | 19.0151  | 16.5778  | 15.9068  | 13.7264 | 12.7195 | 14.5958 | 14.7701 | 17.2132  | 18.7895  | 20.4042 (46)                      |
| Water storage loss:                      |                      |          |          |          |          |         |         |         |         |          |          |                                   |
| Store volume                             |                      |          |          |          |          |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |             |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|-------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |             |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51) |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52) |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53) |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55) |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |             |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144     | (56)           |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |             |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144     | (57)           |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624     | (59)           |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |             |                |
|                                                                 | 195.7367 | 172.7745 | 182.0440 | 164.0124 | 161.3221 | 145.0027 | 140.0734 | 152.5821                                 | 151.9611 | 170.0311 | 178.7570 | 191.3047    | (62)           |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000      | (63)           |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |             | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |             |                |
|                                                                 | 195.7367 | 172.7745 | 182.0440 | 164.0124 | 161.3221 | 145.0027 | 140.0734 | 152.5821                                 | 151.9611 | 170.0311 | 178.7570 | 191.3047    | (64)           |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |             | 2005.6019 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |             |                |
|                                                                 | 90.9243  | 80.7886  | 86.3715  | 79.5424  | 79.4815  | 73.2217  | 72.4163  | 76.5755                                  | 75.5354  | 82.3773  | 84.4450  | 89.4507     | (65)           |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 527.3704 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 553.7389 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2005.6019 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2105.8820 (310a) |
| Electricity used for heat distribution                                                  | 26.5962 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 108.1805 (330a)  |
| Total electricity for the above, kWh/year                                               | 108.1805 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 301.5609 (332)   |
| Total delivered energy for all uses                                                     | 3069.3623 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2799.6010          | 0.2160                        | 604.7138 (367)           |
| Electrical energy for heat distribution                                                    | 26.5962            | 0.5190                        | 13.8034 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 618.5172 (373)           |
| Space and water heating                                                                    |                    |                               | 618.5172 (376)           |
| Pumps and fans                                                                             | 108.1805           | 0.5190                        | 56.1457 (378)            |
| Energy for lighting                                                                        | 301.5609           | 0.5190                        | 156.5101 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 831.1730 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.3000 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.3000 ZC1 |
| Total Floor Area                                                                | TFA | 67.5600     |
| Assumed number of occupants                                                     | N   | 2.1855      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.8000 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5378 ZC3  |
| Total CO2 emissions                                                             |     | 31.6377 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 31.6377 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.5600 (1b)              | x 2.5000 (2b)                   | = 168.9000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.5600                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.9000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | +                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 2 * 10 =        | 20.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             |                 | Air changes per hour    |
| Pressure test                                                             |                 |                      |                             | 20.0000 / (5) = | 0.1184 (8)              |
| Measured/design AP50                                                      |                 |                      |                             |                 | Yes                     |
| Infiltration rate                                                         |                 |                      |                             |                 | 5.0000                  |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0.3684 (18)             |
|                                                                           |                 |                      |                             |                 | 3 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.7750 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.2855 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3640 | 0.3569 | 0.3498 | 0.3141 | 0.3069 | 0.2712 | 0.2712 | 0.2641 | 0.2855 | 0.3069 | 0.3212 | 0.3355 (22b) |
| Effective ac    | 0.5663 | 0.5637 | 0.5612 | 0.5493 | 0.5471 | 0.5368 | 0.5368 | 0.5349 | 0.5408 | 0.5471 | 0.5516 | 0.5563 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 14.4000              | 1.3258           | 19.0909      |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 21.2155     | 14.4000        | 6.8155               | 0.1800           | 1.2268       |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 21.2155              |                  |              |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  |              | 20.3177           |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |                      |                  |              |                   |               | 1.0608 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 21.3785       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 31.5617     | 31.4183        | 31.2778              | 30.6175          | 30.4940      | 29.9189           | 29.9189       | 29.8124       | 30.1404 | 30.4940 | 30.7439 | 31.0051 | (38) |
| Heat transfer coeff                                                 | 52.9402     | 52.7968        | 52.6562              | 51.9960          | 51.8724      | 51.2974           | 51.2974       | 51.1909       | 51.5189 | 51.8724 | 52.1223 | 52.3836 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |               |         |         |         | 51.9954 | (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.7836      | 0.7815         | 0.7794               | 0.7696           | 0.7678       | 0.7593            | 0.7593        | 0.7577        | 0.7626  | 0.7678  | 0.7715  | 0.7754  | (40) |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |               |         |         |         | 0.7696  | (40) |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |          |              |               |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|--------------|---------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |          |              | 2.1855 (42)   |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |          |              | 86.1047 (43)  |
| Daily hot water use                                         | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov          | Dec           |
| Energy conte                                                | 94.7152  | 91.2710  | 87.8268  | 84.3826  | 80.9384  | 77.4942 | 77.4942 | 80.9384 | 84.3826 | 87.8268  | 91.2710      | 94.7152 (44)  |
| Energy content (annual)                                     | 140.4599 | 122.8471 | 126.7672 | 110.5187 | 106.0453 | 91.5091 | 84.7966 | 97.3053 | 98.4675 | 114.7543 | 125.2633     | 136.0279 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |         |         |          |              |               |
| 21.0690                                                     | 18.4271  | 19.0151  | 16.5778  | 15.9068  | 13.7264  | 12.7195 | 14.5958 | 14.7701 | 17.2132 | 18.7895  | 20.4042 (46) |               |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |          |              |               |
| Store volume                                                |          |          |          |          |          |         |         |         |         |          |              | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |          |              | 1.3938 (48)   |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |          |              | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |          |              | 0.7527 (55)   |
| Total storage loss                                          |          |          |          |          |          |         |         |         |         |          |              |               |
| 23.3325                                                     | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798  | 23.3325 (56) |               |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |          |              |               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 187.0548 | 164.9328 | 173.3621 | 155.6105 | 152.6402 | 136.6009 | 131.3915 | 143.9002                      | 143.5593    | 161.3492 | 170.3552 | 182.6228 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 187.0548 | 164.9328 | 173.3621 | 155.6105 | 152.6402 | 136.6009 | 131.3915 | 143.9002                      | 143.5593    | 161.3492 | 170.3552 | 182.6228 (64)  |
|                                                                 | 83.9788  | 74.5152  | 79.4260  | 72.8209  | 72.5360  | 66.5002  | 65.4708  | 69.6299                       | 68.8139     | 75.4317  | 77.7235  | 82.5052 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1903.3795 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.1061  | 15.1935  | 12.3562  | 9.3544   | 6.9925   | 5.9034   | 6.3788   | 8.2914   | 11.1287  | 14.1305  | 16.4924  | 17.5815  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 191.5366 | 193.5241 | 188.5156 | 177.8529 | 164.3933 | 151.7431 | 143.2920 | 141.3044 | 146.3130 | 156.9756 | 170.4353 | 183.0855 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | (71) |
| Water heating gains (Table 5)                                                       | 112.8748 | 110.8858 | 106.7554 | 101.1402 | 97.4946  | 92.3614  | 87.9984  | 93.5886  | 95.5749  | 101.3867 | 107.9493 | 110.8941 | (72) |
| Total internal gains                                                                | 380.2993 | 378.3853 | 366.4090 | 347.1295 | 327.6623 | 308.7898 | 296.4511 | 301.9664 | 311.7985 | 331.2748 | 353.6589 | 370.3430 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|----------|------------------------------|---------------|
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |          |          |          |                              |               |
| Southwest   |          |          |          |          | 14.4000    | 36.7938                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       | 161.9233 (79) |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |          |          |          |                              |               |
| Solar gains | 161.9233 | 275.8153 | 377.3825 | 467.5952 | 523.7456   | 519.9582                       | 501.2951                          | 459.4044                           | 408.6254 | 304.8346 | 193.9468 | 138.5726                     | (83)          |
| Total gains | 542.2226 | 654.2006 | 743.7915 | 814.7247 | 851.4079   | 828.7480                       | 797.7462                          | 761.3709                           | 720.4240 | 636.1094 | 547.6057 | 508.9156                     | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |              | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |              |
| tau                                                                         | 88.6220 | 88.8627 | 89.0999 | 90.2314 | 90.4463 | 91.4602 | 91.4602 | 91.6505 | 91.0670                   | 90.4463 | 90.0126 | 89.5636      |              |
| alpha                                                                       | 6.9081  | 6.9242  | 6.9400  | 7.0154  | 7.0298  | 7.0973  | 7.0973  | 7.1100  | 7.0711                    | 7.0298  | 7.0008  | 6.9709       |              |
| util living area                                                            | 0.9865  | 0.9570  | 0.8852  | 0.7394  | 0.5620  | 0.3958  | 0.2829  | 0.3092  | 0.4917                    | 0.7929  | 0.9615  | 0.9906 (86)  |              |
| MIT                                                                         | 20.4799 | 20.6663 | 20.8433 | 20.9601 | 20.9942 | 20.9996 | 21.0000 | 20.9999 | 20.9982                   | 20.9476 | 20.7044 | 20.4392 (87) |              |
| Th 2                                                                        | 20.2676 | 20.2694 | 20.2712 | 20.2797 | 20.2813 | 20.2888 | 20.2888 | 20.2901 | 20.2859                   | 20.2813 | 20.2781 | 20.2747 (88) |              |
| util rest of house                                                          | 0.9828  | 0.9467  | 0.8627  | 0.7034  | 0.5202  | 0.3520  | 0.2372  | 0.2615  | 0.4416                    | 0.7524  | 0.9504  | 0.9880 (89)  |              |
| MIT 2                                                                       | 19.5860 | 19.8501 | 20.0889 | 20.2390 | 20.2764 | 20.2885 | 20.2887 | 20.2901 | 20.2847                   | 20.2297 | 19.9142 | 19.5334 (90) |              |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4895 (91)  |              |
| MIT                                                                         | 20.0235 | 20.2496 | 20.4582 | 20.5920 | 20.6278 | 20.6366 | 20.6369 | 20.6376 | 20.6339                   | 20.5811 | 20.3010 | 19.9768 (92) |              |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |              |
| adjusted MIT                                                                | 20.0235 | 20.2496 | 20.4582 | 20.5920 | 20.6278 | 20.6366 | 20.6369 | 20.6376 | 20.6339                   | 20.5811 | 20.3010 | 19.9768 (93) |              |

#### 8. Space heating requirement

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.9813   | 0.9464   | 0.8688   | 0.7193   | 0.5405   | 0.3734   | 0.2596   | 0.2849   | 0.4661   | 0.7699       | 0.9508   | 0.9866 (94)   |
| Useful gains         | 532.0974 | 619.1475 | 646.1983 | 586.0566 | 460.1609 | 309.4809 | 207.0707 | 216.9041 | 335.7925 | 489.7207     | 520.6674 | 502.1146 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 832.4069 | 810.4118 | 734.9858 | 607.9349 | 463.1048 | 309.6602 | 207.0814 | 216.9247 | 336.6203 | 517.7433     | 688.0662 | 826.4440 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 223.4303 | 128.5296 | 66.0579  | 15.7524  | 2.1902   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 20.8488      | 120.5272 | 241.3011 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 818.6375 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 12.1172 (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)   |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)   |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 875.5481 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                |
| Space heating requirement                                             | 223.4303 | 128.5296 | 66.0579  | 15.7524  | 2.1902   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 20.8488  | 120.5272 | 241.3011  | (98)           |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)          |
| Space heating fuel (main heating system)                              | 238.9629 | 137.4648 | 70.6501  | 16.8475  | 2.3425   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 22.2982  | 128.9061 | 258.0760  | (211)          |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)          |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Water heating requirement                                             | 187.0548 | 164.9328 | 173.3621 | 155.6105 | 152.6402 | 136.6009 | 131.3915 | 143.9002 | 143.5593 | 161.3492 | 170.3552 | 182.6228  | (64)           |
| Efficiency of water heater                                            | 85.2887  | 84.1579  | 82.4910  | 80.6768  | 79.9337  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8944  | 83.9107  | 79.8000   | (216)          |
| (217)m                                                                | 85.2887  | 84.1579  | 82.4910  | 80.6768  | 79.9337  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8944  | 83.9107  | 85.5579   | (217)          |
| Fuel for water heating, kWh/month                                     | 219.3194 | 195.9801 | 210.1589 | 192.8813 | 190.9586 | 171.1791 | 164.6510 | 180.3261 | 179.8989 | 199.4565 | 203.0195 | 213.4492  | (219)          |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2321.2787 | (219)          |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 875.5481  | (211)          |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)          |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)         |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)         |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)          |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 302.0988  | (232)          |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3573.9256 | (238)          |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 875.5481           | 0.2160                        | 189.1184 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2321.2787          | 0.2160                        | 501.3962 (264)           |
| Space and water heating                                                                           |                    |                               | 690.5146 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 302.0988           | 0.5190                        | 156.7893 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 886.2289 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 10.2208 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3207 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5762 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (10.2208 * 1.00) + 2.3207 + 0.5762, rounded to 2 d.p. |                    |                               | 13.1200 (273)            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                     |               |              |                |            |
|------------------------------------|-------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | INDEX_001490                        |               |              | Issued on Date | 18/04/2019 |
| Assessment Reference               | 001                                 | Prop Type Ref | B_2_13.15_1B |                |            |
| Property                           | B_2_13.15_1B                        |               |              |                |            |
|                                    |                                     |               |              |                |            |
| SAP Rating                         | 86 B                                | DER           | 11.19        | TER            | 13.12      |
| Environmental                      | 91 B                                | % DER<TER     | 14.70        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.72                                | DFEE          | 19.29        | TFEE           | 20.99      |
| General Requirements Compliance    | Fail                                | % DFEE<TFEE   | 8.12         |                |            |
|                                    |                                     |               |              |                |            |
| Assessor Details                   | admin Admin, BuroHappold, Tel: -, - |               |              | Assessor ID    | Admin      |
| Client                             |                                     |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 13.12 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 11.19 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)21.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)19.3 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Floor (no floor) |                  |                  |    |
| Roof (no roof)   |                  |                  |    |
| Openings         | 1.00 (max. 2.00) | 1.00 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated using default  $\psi$ -value of 0.15

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                   |             |
|-------------------|-------------|
| Hot water storage | No cylinder |
|-------------------|-------------|

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinder

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.42   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 91%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing South West: | 14.40 m <sup>2</sup> , No overhang |
| Air change rate:           | 2.00 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                  |                                      |
|------------------|--------------------------------------|
| Window U-value   | 1.00 W/m <sup>2</sup> K              |
| Air permeability | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.5600 (1b)              | x 2.5000 (2b)                   | = 168.9000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.5600                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.9000 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1163 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 77.3500 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2615 | 0.2586 | 0.2557 | 0.2411 | 0.2382 | 0.2237 | 0.2237 | 0.2208 | 0.2295 | 0.2382 | 0.2440 | 0.2498 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K              |         |         |         |         |              |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|----------------------------|---------|---------|---------|---------|--------------|
| Opening Type 1 (Uw = 1.00)                                          |             |                | 14.4000              | 0.9615           | 13.8462      |                   | (27)                       |         |         |         |         |              |
| External Wall 1                                                     | 21.2155     | 14.4000        | 6.8155               | 0.1600           | 1.0905       |                   | (29a)                      |         |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 21.2155              |                  |              |                   | (31)                       |         |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  | 14.9366      |                   | (33)                       |         |         |         |         |              |
| Party Floor 1                                                       |             |                | 67.5600              |                  |              |                   | (32d)                      |         |         |         |         |              |
| Party Ceilings 1                                                    |             |                | 67.5600              |                  |              |                   | (32b)                      |         |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   | 100.0000 (35)              |         |         |         |         |              |
| Thermal bridges (Default value 0.150 * total exposed area)          |             |                |                      |                  |              |                   | 3.1823 (36)                |         |         |         |         |              |
| Total fabric heat loss                                              |             |                |                      |                  |              |                   | (33) + (36) = 18.1190 (37) |         |         |         |         |              |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |                            |         |         |         |         |              |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| (38)m                                                               | 14.5735     | 14.4115        | 14.2495              | 13.4396          | 13.2776      | 12.4677           | 12.4677                    | 12.3057 | 12.7916 | 13.2776 | 13.6016 | 13.9255 (38) |
| Heat transfer coeff                                                 | 32.6924     | 32.5305        | 32.3685              | 31.5585          | 31.3966      | 30.5866           | 30.5866                    | 30.4246 | 30.9106 | 31.3966 | 31.7205 | 32.0445 (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |                            |         |         |         |         | 31.5180 (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul                        | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 0.4839      | 0.4815         | 0.4791               | 0.4671           | 0.4647       | 0.4527            | 0.4527                     | 0.4503  | 0.4575  | 0.4647  | 0.4695  | 0.4743 (40)  |
| HLP (average)                                                       |             |                |                      |                  |              |                   |                            |         |         |         |         | 0.4665 (40)  |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31                         | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |          |         |         |         |         |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |         |         |          |          | 2.1855 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |         |         |          |          | 86.1047 (43)                      |
| Daily hot water use                      | 94.7152  | 91.2710  | 87.8268  | 84.3826  | 80.9384  | 77.4942 | 77.4942 | 80.9384 | 84.3826 | 87.8268  | 91.2710  | 94.7152 (44)                      |
| Energy conte                             | 140.4599 | 122.8471 | 126.7672 | 110.5187 | 106.0453 | 91.5091 | 84.7966 | 97.3053 | 98.4675 | 114.7543 | 125.2633 | 136.0279 (45)                     |
| Energy content (annual)                  |          |          |          |          |          |         |         |         |         |          |          | Total = Sum(45)m = 1354.7621 (45) |
| Distribution loss (46)m = 0.15 x (45)m   |          |          |          |          |          |         |         |         |         |          |          |                                   |
|                                          | 21.0690  | 18.4271  | 19.0151  | 16.5778  | 15.9068  | 13.7264 | 12.7195 | 14.5958 | 14.7701 | 17.2132  | 18.7895  | 20.4042 (46)                      |
| Water storage loss:                      |          |          |          |          |          |         |         |         |         |          |          |                                   |
| Store volume                             |          |          |          |          |          |         |         |         |         |          |          | 110.0000 (47)                     |



|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|---------------|----------------|
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |                                          |          |          |          | 0.0152 (51)   |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |                                          |          |          |          | 1.0294 (52)   |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 0.6000 (53)   |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 1.0327 (55)   |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 32.0144  | 28.9162  | 32.0144  | 30.9817  | 32.0144  | 30.9817  | 32.0144  | 32.0144                                  | 30.9817  | 32.0144  | 30.9817  | 32.0144 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 195.7367 | 172.7745 | 182.0440 | 164.0124 | 161.3221 | 145.0027 | 140.0734 | 152.5821                                 | 151.9611 | 170.0311 | 178.7570 | 191.3047 (62) |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          |               | 0.0000 (63)    |
| Output from w/h                                                 | 195.7367 | 172.7745 | 182.0440 | 164.0124 | 161.3221 | 145.0027 | 140.0734 | 152.5821                                 | 151.9611 | 170.0311 | 178.7570 | 191.3047 (64) |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          |               | 2005.6019 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |               |                |
|                                                                 | 90.9243  | 80.7886  | 86.3715  | 79.5424  | 79.4815  | 73.2217  | 72.4163  | 76.5755                                  | 75.5354  | 82.3773  | 84.4450  | 89.4507 (65)  |                |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.0756  | 15.1664  | 12.3342  | 9.3378   | 6.9801   | 5.8929   | 6.3675   | 8.2767   | 11.1089  | 14.1053  | 16.4630  | 17.5502 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 191.5366 | 193.5241 | 188.5156 | 177.8529 | 164.3933 | 151.7431 | 143.2920 | 141.3044 | 146.3130 | 156.9756 | 170.4353 | 183.0855 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 (71) |
| Water heating gains (Table 5)                                                       | 122.2101 | 120.2211 | 116.0908 | 110.4756 | 106.8300 | 101.6968 | 97.3337  | 102.9240 | 104.9102 | 110.7221 | 117.2847 | 120.2294 (72) |
| Total internal gains                                                                | 386.6043 | 384.6936 | 372.7224 | 353.4482 | 333.9853 | 315.1147 | 302.7751 | 308.2870 | 318.1141 | 337.5850 | 359.9649 | 376.6471 (73) |

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|----------|----------|---------------|
| Southwest   |          |          |          | 14.4000    | 36.7938                        | 0.5000                            | 0.8000                             | 0.7700                       | 146.8692 (79) |          |          |               |
| Solar gains | 146.8692 | 250.1726 | 342.2970 | 424.1226   | 475.0527                       | 471.6174                          | 454.6895                           | 416.6934                     | 370.6353      | 276.4940 | 175.9155 | 125.6894 (83) |
| Total gains | 533.4735 | 634.8662 | 715.0195 | 777.5708   | 809.0380                       | 786.7321                          | 757.4646                           | 724.9804                     | 688.7494      | 614.0790 | 535.8804 | 502.3365 (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nll,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 57.4037 | 57.6895 | 57.9782 | 59.4662 | 59.7730 | 61.3558 | 61.3558 | 61.6825 | 60.7127                   | 59.7730 | 59.1625 | 58.5644      |
| alpha                                                                       | 4.8269  | 4.8460  | 4.8652  | 4.9644  | 4.9849  | 5.0904  | 5.0904  | 5.1122  | 5.0475                    | 4.9849  | 4.9442  | 4.9043       |
| util living area                                                            | 0.8378  | 0.7408  | 0.6246  | 0.4837  | 0.3595  | 0.2487  | 0.1777  | 0.1930  | 0.3091                    | 0.5208  | 0.7418  | 0.8580 (86)  |
| MIT                                                                         | 20.6596 | 20.8161 | 20.9217 | 20.9800 | 20.9960 | 20.9996 | 20.9999 | 20.9999 | 20.9986                   | 20.9767 | 20.8498 | 20.6294 (87) |
| Th 2                                                                        | 20.5356 | 20.5378 | 20.5400 | 20.5511 | 20.5533 | 20.5643 | 20.5643 | 20.5666 | 20.5599                   | 20.5533 | 20.5489 | 20.5444 (88) |
| util rest of house                                                          | 0.8263  | 0.7263  | 0.6081  | 0.4667  | 0.3425  | 0.2318  | 0.1601  | 0.1748  | 0.2895                    | 0.5001  | 0.7253  | 0.8475 (89)  |
| MIT 2                                                                       | 20.0825 | 20.2980 | 20.4409 | 20.5269 | 20.5488 | 20.5639 | 20.5643 | 20.5665 | 20.5585                   | 20.5259 | 20.3565 | 20.0487 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fIA = Living area / (4) = |         |         | 0.4895 (91)  |
| MIT                                                                         | 20.3650 | 20.5516 | 20.6763 | 20.7487 | 20.7677 | 20.7772 | 20.7775 | 20.7786 | 20.7739                   | 20.7466 | 20.5980 | 20.3330 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 20.3650 | 20.5516 | 20.6763 | 20.7487 | 20.7677 | 20.7772 | 20.7775 | 20.7786 | 20.7739                   | 20.7466 | 20.5980 | 20.3330 (93) |

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|---------------|
| Utilisation          | 0.8218   | 0.7268   | 0.6131   | 0.4742   | 0.3506   | 0.2400   | 0.1687   | 0.1837   | 0.2990   | 0.5091       | 0.7271   | 0.8423 (94)   |
| Useful gains         | 438.4343 | 461.4047 | 438.3466 | 368.7376 | 283.6800 | 188.8380 | 127.7646 | 133.2000 | 205.9664 | 312.6331     | 389.6356 | 423.1346 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 525.2045 | 509.1537 | 458.8643 | 373.9273 | 284.6934 | 188.9388 | 127.7770 | 133.2188 | 206.2956 | 318.5677     | 428.1629 | 516.9729 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 64.5570  | 32.0874  | 15.2652  | 3.7366   | 0.7540   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 4.4153       | 27.7397  | 69.8157 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 218.3708 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 3.2323 (99)   |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |               |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.09r14

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 218.3708 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05                                     | 229.2894 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2005.6019 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05                                     | 2105.8820 (310a) |
| Electricity used for heat distribution                                                  | 23.3517 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5250)              |                  |
| mechanical ventilation fans (SFP = 0.5250)                                              | 108.1805 (330a)  |
| Total electricity for the above, kWh/year                                               | 108.1805 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 301.5609 (332)   |
| Total delivered energy for all uses                                                     | 2744.9127 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 95.0000 (367a)           |
| Space heating from Boilers                                                                 | 2458.0751          | 0.2160                        | 530.9442 (367)           |
| Electrical energy for heat distribution                                                    | 23.3517            | 0.5190                        | 12.1195 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 543.0638 (373)           |
| Space and water heating                                                                    |                    |                               | 543.0638 (376)           |
| Pumps and fans                                                                             | 108.1805           | 0.5190                        | 56.1457 (378)            |
| Energy for lighting                                                                        | 301.5609           | 0.5190                        | 156.5101 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 755.7195 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 11.1900 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 11.1900 ZC1 |
| Total Floor Area                                                                | TFA | 67.5600     |
| Assumed number of occupants                                                     | N   | 2.1855      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.8000 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5378 ZC3  |
| Total CO2 emissions                                                             |     | 30.5277 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 30.5277 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 67.5600 (1b)              | x 2.5000 (2b)                   | = 168.9000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 67.5600                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 168.9000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1184 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3684 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.2855 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3640 | 0.3569 | 0.3498 | 0.3141 | 0.3069 | 0.2712 | 0.2712 | 0.2641 | 0.2855 | 0.3069 | 0.3212 | 0.3355 (22b) |
| Effective ac    | 0.5663 | 0.5637 | 0.5612 | 0.5493 | 0.5471 | 0.5368 | 0.5368 | 0.5349 | 0.5408 | 0.5471 | 0.5516 | 0.5563 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|---------------------------------------------------------------------|-------------|----------------|----------------------|------------------|--------------|-------------------|---------------|---------------|---------|---------|---------|---------|------|
| Element                                                             | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |               |         |         |         |         |      |
| TER Opening Type (Uw = 1.40)                                        |             |                | 14.4000              | 1.3258           | 19.0909      |                   |               | (27)          |         |         |         |         |      |
| External Wall 1                                                     | 21.2155     | 14.4000        | 6.8155               | 0.1800           | 1.2268       |                   |               | (29a)         |         |         |         |         |      |
| Total net area of external elements Aum(A, m2)                      |             |                | 21.2155              |                  |              |                   |               | (31)          |         |         |         |         |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                | (26)...(30) + (32) = |                  |              | 20.3177           |               | (33)          |         |         |         |         |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |                      |                  |              |                   |               | 250.0000 (35) |         |         |         |         |      |
| Thermal bridges (User defined value 0.050 * total exposed area)     |             |                |                      |                  |              |                   |               | 1.0608 (36)   |         |         |         |         |      |
| Total fabric heat loss                                              |             |                |                      |                  |              | (33) + (36) =     | 21.3785       | (37)          |         |         |         |         |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |             |                |                      |                  |              |                   |               |               |         |         |         |         |      |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| (38)m                                                               | 31.5617     | 31.4183        | 31.2778              | 30.6175          | 30.4940      | 29.9189           | 29.9189       | 29.8124       | 30.1404 | 30.4940 | 30.7439 | 31.0051 | (38) |
| Heat transfer coeff                                                 | 52.9402     | 52.7968        | 52.6562              | 51.9960          | 51.8724      | 51.2974           | 51.2974       | 51.1909       | 51.5189 | 51.8724 | 52.1223 | 52.3836 | (39) |
| Average = Sum(39)m / 12 =                                           |             |                |                      |                  |              |                   |               |               |         |         |         | 51.9954 | (39) |
|                                                                     | Jan         | Feb            | Mar                  | Apr              | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec     |      |
| HLP                                                                 | 0.7836      | 0.7815         | 0.7794               | 0.7696           | 0.7678       | 0.7593            | 0.7593        | 0.7577        | 0.7626  | 0.7678  | 0.7715  | 0.7754  | (40) |
| HLP (average)                                                       |             |                |                      |                  |              |                   |               |               |         |         |         | 0.7696  | (40) |
| Days in month                                                       | 31          | 28             | 31                   | 30               | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31      | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.1855 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.1047 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             | 94.7152  | 91.2710  | 87.8268  | 84.3826  | 80.9384  | 77.4942 | 77.4942 | 80.9384 | 84.3826 | 87.8268            | 91.2710  | 94.7152 (44)   |
| Energy conte                                                | 140.4599 | 122.8471 | 126.7672 | 110.5187 | 106.0453 | 91.5091 | 84.7966 | 97.3053 | 98.4675 | 114.7543           | 125.2633 | 136.0279 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1354.7621 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             | 21.0690  | 18.4271  | 19.0151  | 16.5778  | 15.9068  | 13.7264 | 12.7195 | 14.5958 | 14.7701 | 17.2132            | 18.7895  | 20.4042 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 1.3938 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.7527 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |         |         |                    |          |                |
|                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325            | 22.5798  | 23.3325 (56)   |
| If cylinder contains dedicated solar storage                |          |          |          |          |          |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                               |             |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|----------|----------|----------------|
| Primary loss                                                    | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325                       | 22.5798     | 23.3325  | 22.5798  | 23.3325 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624  | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 187.0548 | 164.9328 | 173.3621 | 155.6105 | 152.6402 | 136.6009 | 131.3915 | 143.9002                      | 143.5593    | 161.3492 | 170.3552 | 182.6228 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |          |          | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 187.0548 | 164.9328 | 173.3621 | 155.6105 | 152.6402 | 136.6009 | 131.3915 | 143.9002                      | 143.5593    | 161.3492 | 170.3552 | 182.6228 (64)  |
|                                                                 | 83.9788  | 74.5152  | 79.4260  | 72.8209  | 72.5360  | 66.5002  | 65.4708  | 69.6299                       | 68.8139     | 75.4317  | 77.7235  | 82.5052 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |          |          | 1903.3795 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | 109.2730 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.1061  | 15.1935  | 12.3562  | 9.3544   | 6.9925   | 5.9034   | 6.3788   | 8.2914   | 11.1287  | 14.1305  | 16.4924  | 17.5815  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 191.5366 | 193.5241 | 188.5156 | 177.8529 | 164.3933 | 151.7431 | 143.2920 | 141.3044 | 146.3130 | 156.9756 | 170.4353 | 183.0855 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | 33.9273  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | -87.4184 | (71) |
| Water heating gains (Table 5)                                                       | 112.8748 | 110.8858 | 106.7554 | 101.1402 | 97.4946  | 92.3614  | 87.9984  | 93.5886  | 95.5749  | 101.3867 | 107.9493 | 110.8941 | (72) |
| Total internal gains                                                                | 380.2993 | 378.3853 | 366.4090 | 347.1295 | 327.6623 | 308.7898 | 296.4511 | 301.9664 | 311.7985 | 331.2748 | 353.6589 | 370.3430 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|----------|------------------------------|---------------|
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |          |          |          |                              |               |
| Southwest   |          |          |          |          | 14.4000    | 36.7938                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       | 161.9233 (79) |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |          |          |          |                              |               |
| Solar gains | 161.9233 | 275.8153 | 377.3825 | 467.5952 | 523.7456   | 519.9582                       | 501.2951                          | 459.4044                           | 408.6254 | 304.8346 | 193.9468 | 138.5726                     | (83)          |
| Total gains | 542.2226 | 654.2006 | 743.7915 | 814.7247 | 851.4079   | 828.7480                       | 797.7462                          | 761.3709                           | 720.4240 | 636.1094 | 547.6057 | 508.9156                     | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 88.6220 | 88.8627 | 89.0999 | 90.2314 | 90.4463 | 91.4602 | 91.4602 | 91.6505 | 91.0670                   | 90.4463 | 90.0126 | 89.5636 |              |
| alpha                                                                       | 6.9081  | 6.9242  | 6.9400  | 7.0154  | 7.0298  | 7.0973  | 7.0973  | 7.1100  | 7.0711                    | 7.0298  | 7.0008  | 6.9709  |              |
| util living area                                                            | 0.9865  | 0.9570  | 0.8852  | 0.7394  | 0.5620  | 0.3958  | 0.2829  | 0.3092  | 0.4917                    | 0.7929  | 0.9615  | 0.9906  | (86)         |
| MIT                                                                         | 20.4799 | 20.6663 | 20.8433 | 20.9601 | 20.9942 | 20.9996 | 21.0000 | 20.9999 | 20.9982                   | 20.9476 | 20.7044 | 20.4392 | (87)         |
| Th 2                                                                        | 20.2676 | 20.2694 | 20.2712 | 20.2797 | 20.2813 | 20.2888 | 20.2888 | 20.2901 | 20.2859                   | 20.2813 | 20.2781 | 20.2747 | (88)         |
| util rest of house                                                          | 0.9828  | 0.9467  | 0.8627  | 0.7034  | 0.5202  | 0.3520  | 0.2372  | 0.2615  | 0.4416                    | 0.7524  | 0.9504  | 0.9880  | (89)         |
| MIT 2                                                                       | 19.5860 | 19.8501 | 20.0889 | 20.2390 | 20.2764 | 20.2885 | 20.2887 | 20.2901 | 20.2847                   | 20.2297 | 19.9142 | 19.5334 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4895  | (91)         |
| MIT                                                                         | 20.0235 | 20.2496 | 20.4582 | 20.5920 | 20.6278 | 20.6366 | 20.6369 | 20.6376 | 20.6339                   | 20.5811 | 20.3010 | 19.9768 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 20.0235 | 20.2496 | 20.4582 | 20.5920 | 20.6278 | 20.6366 | 20.6369 | 20.6376 | 20.6339                   | 20.5811 | 20.3010 | 19.9768 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec      |       |
|                      | 0.9813   | 0.9464   | 0.8688   | 0.7193   | 0.5405   | 0.3734   | 0.2596   | 0.2849   | 0.4661   | 0.7699       | 0.9508   | 0.9866   | (94)  |
| Useful gains         | 532.0974 | 619.1475 | 646.1983 | 586.0566 | 460.1609 | 309.4809 | 207.0707 | 216.9041 | 335.7925 | 489.7207     | 520.6674 | 502.1146 | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000   | (96)  |
| Heat loss rate W     | 832.4069 | 810.4118 | 734.9858 | 607.9349 | 463.1048 | 309.6602 | 207.0814 | 216.9247 | 336.6203 | 517.7433     | 688.0662 | 826.4440 | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000   | (97a) |
| Space heating kWh    | 223.4303 | 128.5296 | 66.0579  | 15.7524  | 2.1902   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 20.8488      | 120.5272 | 241.3011 | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 818.6375 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 12.1172  | (99)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          |          |       |

#### 8c. Space cooling requirement

Not applicable

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)   |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)   |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 875.5481 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                |
| Space heating requirement                                             | 223.4303 | 128.5296 | 66.0579  | 15.7524  | 2.1902   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 20.8488  | 120.5272 | 241.3011  | (98)           |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)          |
| Space heating fuel (main heating system)                              | 238.9629 | 137.4648 | 70.6501  | 16.8475  | 2.3425   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 22.2982  | 128.9061 | 258.0760  | (211)          |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)          |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Water heating requirement                                             | 187.0548 | 164.9328 | 173.3621 | 155.6105 | 152.6402 | 136.6009 | 131.3915 | 143.9002 | 143.5593 | 161.3492 | 170.3552 | 182.6228  | (64)           |
| Efficiency of water heater                                            | 85.2887  | 84.1579  | 82.4910  | 80.6768  | 79.9337  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8944  | 83.9107  | 79.8000   | (216)          |
| (217)m                                                                | 85.2887  | 84.1579  | 82.4910  | 80.6768  | 79.9337  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 80.8944  | 83.9107  | 85.5579   | (217)          |
| Fuel for water heating, kWh/month                                     | 219.3194 | 195.9801 | 210.1589 | 192.8813 | 190.9586 | 171.1791 | 164.6510 | 180.3261 | 179.8989 | 199.4565 | 203.0195 | 213.4492  | (219)          |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2321.2787 | (219)          |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 875.5481  | (211)          |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)          |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)         |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)         |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)          |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 302.0988  | (232)          |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3573.9256 | (238)          |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 875.5481           | 0.2160                        | 189.1184 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2321.2787          | 0.2160                        | 501.3962 (264)           |
| Space and water heating                                                                           |                    |                               | 690.5146 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 302.0988           | 0.5190                        | 156.7893 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 886.2289 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 10.2208 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3207 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5762 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (10.2208 * 1.00) + 2.3207 + 0.5762, rounded to 2 d.p. |                    |                               | 13.1200 (273)            |