Energy Strategy
November 2023

ABERFELDY VILLAGE MASTERPLAN

Aberfeldy Village Masterplan

Energy Assessment Report

Updated Planning Issue

Issue P8 – 06 November 2023

ABERFELDY VILLAGE MASTERPLAN

ENERGY ASSESSMENT REPORT

UPDATED PLANNING ISSUE

Quality Assurance Page

Issue	Date	Prepared By	Checked By	Approved By	Remarks
P1	21/9/2021	Mr R. Denteh	Mr R. Wilkes	Mr R. Wilkes	Draft Issue
P2	14/10/2021	Mr R. Denteh	Mr R. Wilkes	Mr R. Wilkes	Planning Issue
P3	25/8/2022	Mr R. Denteh	Mr R. Wilkes	Mr R. Wilkes	Planning Issue
P4	21/10/2022	Mr R. Denteh	Mr R. Wilkes	Mr R. Wilkes	Planning Issue
P5	21/08/2023	Mr W. Newall	Mr R. Denteh	Mr R. Wilkes	Draft Updated Planning Issue
P6	12/09/2023	Mr W. Newall	Mr R. Denteh	Mr R. Wilkes	Draft Updated Planning Issue
P7	21/09/2023	Mr W. Newall	Mr R. Denteh	Mr R. Wilkes	Updated Planning Issue
P8	06/11/2023	Mr R. Wilkes			Updated Planning Issue

Figure 1: 3D aerial sketch of the illustrative Masterplan

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1 Executive Summary

1.1 Introduction

This Energy Assessment Report has been prepared by Meinhardt (UK) Ltd and is submitted in support of an updated hybrid planning application to the Mayor of London for the Aberfeldy Village Masterplan seeking detailed planning permission for Phase A and Outline planning permission for future phases, comprising:

Outline planning permission (all matters reserved) for the demolition of all existing structures and redevelopment to include a number of buildings (up to 100m AOD) and up to 140,591 (GEA) of floorspace comprising the following mix of uses: Residential (Class C3); Retail, workspace, food and drink uses (Class E); Car and cycle parking; Formation of new pedestrian route through the conversion and repurposing of the Abbott Road vehicular underpass for pedestrians and cyclists connecting to Jolly's Green; Landscaping including open spaces and public realm; and New means of access, associated infrastructure and highway works.

In Full, for residential (Class C3), retail, food and drink uses and a temporary marketing suite (Class E and Sui Generis), together with access, car and cycle parking, associated landscaping and new public realm, and open space. This application is accompanied by an Environmental Statement.

The purpose of this Energy Assessment report is to demonstrate how the climate change mitigation measures proposed for the Aberfeldy Village Masterplan address the relevant local, regional and national planning policies. It also demonstrates that energy is an integral part of the proposed development's design.

This report supersedes the Energy Assessment Report Revision P4 dated 21st October 2022 previously submitted in support of the Hybrid Application (LBTH Ref: PA/21/02377/A1 and GLA Ref: 2023/0300/S3) and should therefore be read on a standalone basis.

Following a resolution to refuse planning permission by the SDC in February 2023, and the subsequent direction that the Mayor of London will act as the local planning authority for the purposes of determining the planning application, further amendments have been made to the design of the scheme to accommodate second staircases in all buildings over 18m in height.

For the sake of completeness only it should be noted that the above referenced amendments follow previous amendments to the Hybrid Application, made prior to its consideration by the LBTH SDC, the assessments of which were set out within previous revisions of this Energy Assessment Report. In summary the previously assessed charges were: the incorporation of Jolly's Green within the red line boundary, the removal of the previously proposed Block A3 and associated increase in open space and play space, an increase in the number of affordable rented family homes, and the inclusion of second staircases in Plots F & I.

Further information is set out within the accompanying Covering Letter (as prepared by DP9 Ltd, dated November 2023) and the updated Planning Statement (as prepared by DP9 Ltd, dated November 2023).

This Energy Assessment Report has been updated to reflect the revised Building Regulations 2021 and GLA planning policy introduced since submission of the application to LBTH. Refer to Section 4.

In response to the revised Building Regulations 2021 and updated planning policy, a number of improvements have been made to the scheme to lower energy usage and carbon dioxide emissions including the following;-

- **Waste water heat recovery included to residential dwellings in the detailed part of the application;**
- **Triple glazing included to retail and office space in the detailed part of the application (Blocks F and H);**
- **Improved air tightness to retail and office space in the detailed part of the application (Blocks F and H);**
- **Reduced thermal bridging;**
- **Higher efficiency residential MVHR unit included;**
- **Lower carbon of heat from the existing heat network achieved (through a higher CHP fraction);**
- **Additional photovoltaic panels included;**
- **Efficiency of all photovoltaic panels increased; and**
- **Efficiency of Block I heat pumps increased.**

Using the latest Part L 2021 methodology, this report demonstrates the following improvements since the previous submission (Revision P4 dated 21st October 2022) to LBTH;-

- **34% lower residential fabric energy demand (efficiency) for the detailed part of the application;**
- **8% lower total annual carbon dioxide emissions for the detailed part of the application; and**
- **47.5% lower total annual carbon dioxide emissions for the outline part of the application.**

1.2 Carbon Reduction Policy and Targets

National Policy

The UK Government has made a commitment to bring all greenhouse gas emissions in the UK to net zero by 2050. Further commitments have been made to reducing economy-wide greenhouse gas emissions by at least 68% by 2030 and by 78% by 2035, compared to 1990 levels.

Building Regulations

An updated Building Regulations Part L Conservation of Fuel and Power and a new Part O Overheating were introduced in June 2022. The updated Part L is expected to deliver a 30% improvement on 2013 standards for domestic buildings.

Further consultation is expected on the new Future Homes Standard and Future Buildings Standard which are intended to be introduced in 2025.

London Plan (2021)

Major development should be net zero-carbon, with a minimum on-site reduction of at least 35 per cent beyond Building Regulations Part L 2013 requirements.

Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent reduction through energy efficiency measures.

Where the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, either through a cash in lieu contribution to the borough's carbon offset fund, or off-site provided that an alternative proposal is identified, and delivery is certain.

Carbon emissions from any other part of the development i.e. unregulated emissions, should be calculated and minimised.

Energy Assessment Guidance (2022)

Updated planning guidance has been published by the GLA (in June 2022) which explains how London Plan policies apply now that Part L 2021 has taken effect.

Residential developments are expected to be able to exceed the 35 per cent minimum improvement over Building Regulations Part L 2021 requirements and should aim to achieve at least a 50 per cent improvement.

1.3 Detailed Part of the Application (Phase A)

1.3.1 Carbon Reduction Strategy

The energy strategy for the detailed part of the application follows the London Plan's updated energy hierarchy approach of 'Be Lean', 'Be Clean', 'Be Green', and 'Be Seen' as detailed in policy SI2.

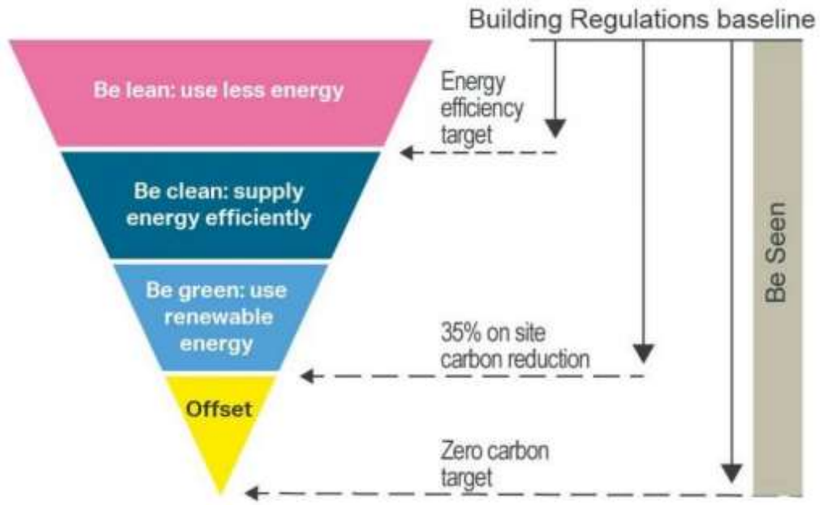


Figure 2: The energy hierarchy and associated targets

The proposed development has been assessed using Elmhurst Design SAP10.2 modelling software and IES dynamic thermal modelling software (SBEM) to demonstrate compliance with Part L 2021.

1.3.2 Carbon Reductions

Domestic Carbon Emissions and Savings (Detailed part of the application)

The expected carbon dioxide emissions at each stage of the hierarchy are shown in the graph below for the residential element of the detailed part of the application.

The graph below demonstrates that the residential element of the detailed part of the application achieves an overall on-site reduction of 28% in regulated carbon dioxide emissions over Part L 2021. It is not possible to meet the London Plan target of 35% due to the carbon content of heat delivered to Blocks F & H by the existing heat network.

In accordance with GLA Energy Assessment Guidance 2022 (see Section 1.3.4 below) Blocks F and H must prioritise a connection to the existing heat network which is currently fed from gas fired CHP and boilers. The heat network operator EON has provided a decarbonisation plan to the GLA which will see the carbon content of heat delivered by the existing network lowered considerably over the forthcoming years.

Energy demand in the residential areas has been significantly reduced, exceeding the GLA target of 10%, achieving a reduction of 15% in regulated carbon emissions over Part L 2021 at the 'Be Lean' stage of the hierarchy, through passive design and energy efficiency measures alone.

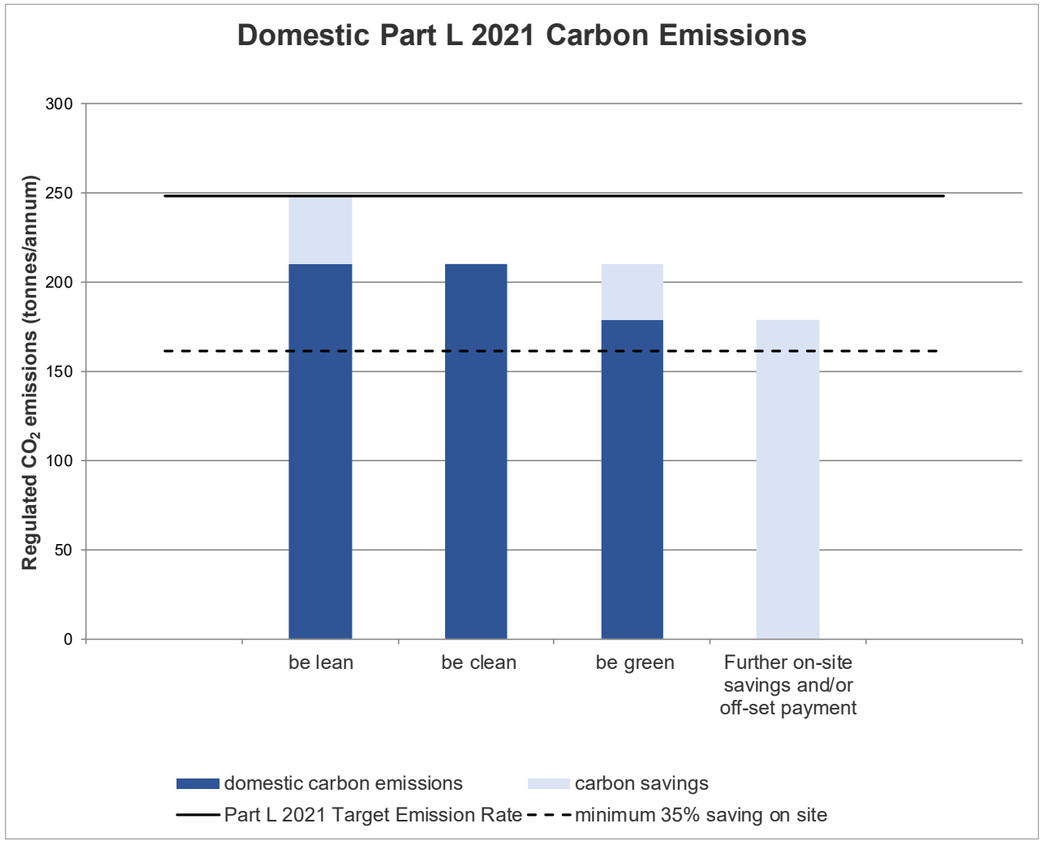


Figure 3: Domestic energy hierarchy and targets for the detailed part of the application

The tables below detail the carbon dioxide emissions and savings expected at each stage of the energy hierarchy for the domestic elements.

	Regulated carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)		
	Block F and H (Existing heat network)	**Blocks I and J (Heat pumps)**	**Total domestic emissions for detailed part of the application**
Baseline: Part L 2021	180.8	67.4	**248.2**
Be Lean	157.1	52.8	**209.8**
Be Clean	157.1	52.8	**209.8**
Be Green	163.5	15.6	**179.1**

Table 1: Carbon dioxide emissions after each stage of the energy hierarchy for domestic elements of the detailed part of the application

	Regulated domestic carbon dioxide savings					
	Block F and H (Existing heat network)		Block I and J (Heat pumps)		Total for detailed part of the application	
	Tonnes CO_2 per	%	Tonnes CO_2 per	%	Tonnes CO_2 per annum	%
Be lean	23.8	13%	14.6	22%	**38.4**	**15%**
Be clean	0	0%	0.0	0%	**0**	**0%**
Be green	-6.4	-4%	37.2	55%	**30.7**	**12%**
Cumulative on site	17.3	10%	51.8	77%	**69.1**	**28%**
Carbon shortfall	163.5		15.6		**179.1**	
					Tonnes CO_2	
Cumulative savings for off-set payment					**5,373**	
Cash-in-lieu contribution					**£510,397**	

Table 2: Regulated carbon dioxide savings from each stage of the energy hierarchy for domestic elements of the detailed part of the application

Non-Domestic Carbon Emissions and Savings

The expected carbon dioxide emissions at each stage of the hierarchy are shown in the graph below for the non-residential element of the detailed part of the application.

The graph below demonstrates that the non-residential element of the detailed part of the application achieves an overall reduction of 30% in regulated carbon dioxide emissions over Part L 2021.

The non-residential elements of the detailed part of the application are primarily located within Blocks F and H, and as with the residential above, it is not possible to meet the London Plan target of 35% due to the carbon content of heat delivered by the existing heat network.

Energy demand in the non-residential areas has been significantly reduced, exceeding the GLA target of 15%, achieving a reduction of 25% in regulated carbon emissions over Part L 2021 at the 'Be Lean' stage of the hierarchy, through passive design and energy efficiency measures alone.

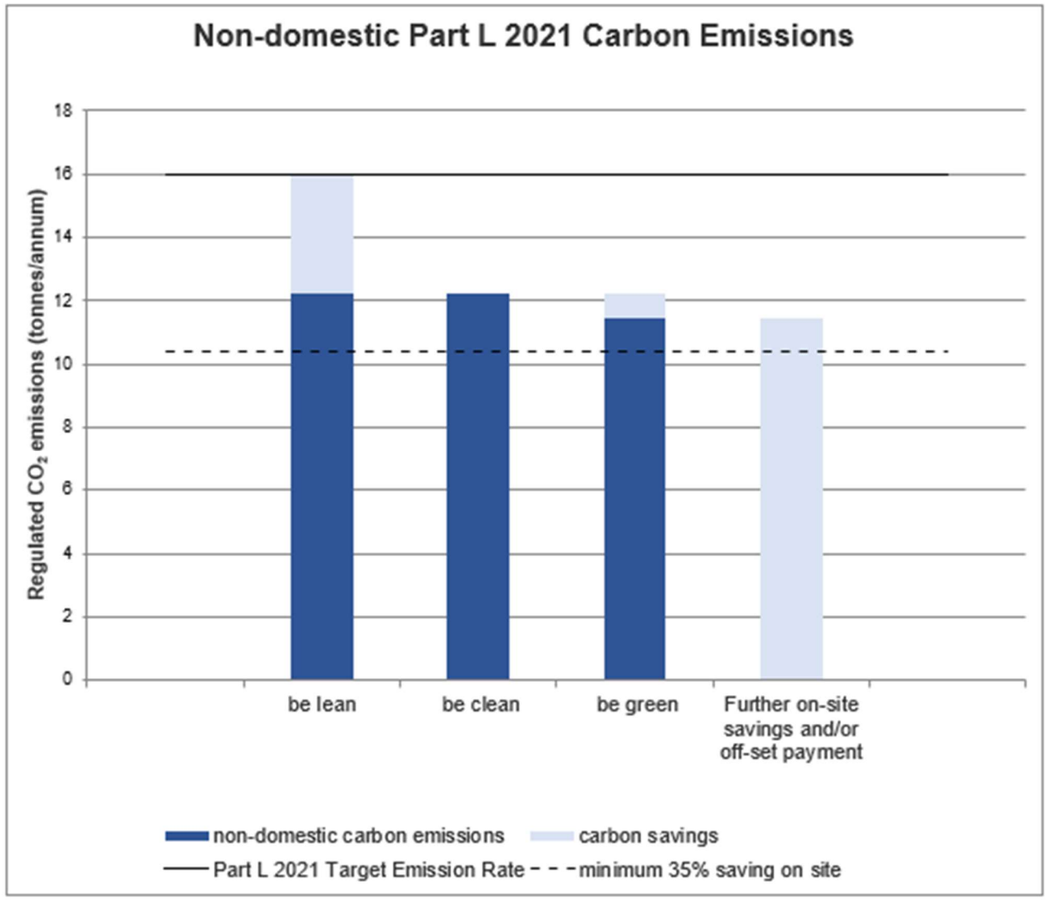


Figure 4: Non-domestic energy hierarchy and targets for the detailed part of the application

The tables below detail the carbon dioxide emissions and savings expected at each stage of the energy hierarchy for the non-domestic elements.

	Regulated carbon dioxide emissions for non-domestic buildings (Tonnes CO_2 per annum)
Baseline: Part L 2021	16.1
Be Lean	12.0
Be Clean	12.0
Be Green	11.2

Table 3: Carbon dioxide emissions after each stage of the energy hierarchy for non-domestic elements of the detailed part of the application

	Regulated non-domestic carbon dioxide savings	
	Tonnes CO_2 per annum	**%**
Be lean	4.1	25%
Be clean	0.0	0%
Be green	0.8	5%
Cumulative on site savings	4.8	30%
Carbon shortfall	11.2	-
	Tonnes CO_2	
Cumulative savings for off-set payment	**337**	
Cash-in-lieu contribution	**£32,058**	

Table 4: Regulated carbon dioxide savings from each stage of the energy hierarchy for non-domestic elements of the detailed part of the application

Total Carbon Emissions and Savings

The table below details the overall carbon dioxide emissions and savings expected at each stage of the energy hierarchy for the detailed part of the application.

	Total regulated emissions (Tonnes CO_2/year)	CO_2 savings (Tonnes CO_2/year)	Percentage saving (%)
Part L 2021 baseline	264.3		
Be Lean	221.9	42.4	16%
Be Clean	221.9	0.0	0%
Be Green	190.3	31.5	12%
Cumulative on site savings	-	74.0	28%
		CO_2 savings off-set (Tonnes CO_2)	
Off-set		5,710.0	

Table 5: Total regulated carbon dioxide emissions and savings for the detailed part of the application

The table above demonstrates that the detailed part of the application as a whole achieves an on-site reduction of 28% in regulated carbon dioxide emissions over Part L 2021.

The table above demonstrates that the total regulated carbon dioxide emissions (using Part L 2021) for the detailed part of the application (190.3 Tonnes/year) are 8% lower than the 206.6 Tonnes/year calculated for the previous submission to LBTH.

1.3.3 Demand Reduction (Be Lean)

Energy demand will be significantly reduced beyond Part L requirements, achieving an overall 16% reduction over Part L 2021 through passive design and energy efficiency measures alone.

The reduction will be achieved by a combination of measures, which shall include the following. Please refer to Section 6 for further details.

- Significantly improved fabric 'U' values (including the addition of triple glazing to the commercial / retail spaces since the previous submission to LBTH)
- Minimised thermal bridging (further improved since the previous submission to LBTH)
- Improved air tightness (further improved in commercial / retail spaces since the previous submission to LBTH)
- Optimised g-value of the glazing – to provide a balance between minimising heat gain in summer (to reduce overheating), maximising useful heat gain in winter (to reduce heating energy) and maximising natural daylight (to reduce lighting energy)
- Waste water heat recovery (WWHR) for the residential (included since the previous submission to LBTH)
- Communal heating systems
- High efficiency ventilation systems (Residential MVHR efficiency further improved since the previous submission to LBTH)
- Minimised heat loss from hot water systems
- Low energy lighting
- Controls systems to monitor and operate the plant and equipment as efficiently as possible.
- Smart meters.

Fabric Energy Efficiency

The table below details the total Part L Fabric Energy Efficiency Standard (FEES) for the residential elements of the detailed part of the application.

	Part L Fabric Energy Efficiency Standard (FEES)		
	Target Fabric Energy Efficiency (kWh/m²)	**Design Fabric Energy Efficiency (kWh/m²)**	**Improvement (%)**
Detailed part of the application	26.21	25.61	2%

Table 6: Part L Fabric Energy Efficiency Standard (FEES) for the residential elements of the detailed part of the application

Energy Use Intensity (EUI) and Space Heating Demand

The table below details the Energy Use Intensity (EUI) and space heating demand for the residential element of the detailed part of the application.

Building type	EUI (kWh/m²/yr)	Space heating demand (kWh/m²/yr)	Methodology used	Explanatory notes
Residential Blocks F and H	79.3	8.9	SAP 10.2	Heat supply from the existing heat network.
Residential Blocks I and J	34.8	14.9	SAP 10.2	Heat supply from heat pumps
Residential Detailed part of the application overall	66.8	10.6	SAP 10.2	Overall EUI is higher than the GLA target as the heat supply to Blocks F & H is from the existing heat network

Table 7: EUI and space heating demand for the residential elements of the detailed part of the application

The table above demonstrates the following;-

- EUI in Blocks F and H residential is above the GLA target of 35 kWh/m²/year as the heat supply is from the existing heat network.
- EUI in Blocks I and J residential is below the GLA target of 35 kWh/m²/year.
- Space heating demand is below the GLA target of 15 kWh/m²/year for all residential areas of the detailed part of the application.

The table below details the Energy Use Intensity (EUI) and space heating demand for the non-residential elements of the detailed part of the application.

Building type	EUI (kWh/m²/yr)	Space heating demand (kWh/m²/yr)	Methodology used	Explanatory notes
Non-residential Blocks F and H	60.5	36.2	CIBSE TM54	Mainly commercial / retail space. Heat supply from the existing heat network.
Non-residential Block I	40	8.2	CIBSE TM54	Residential entrance and amenity space only. Heat supply from heat pumps.
Non-residential Detailed part of the application overall	57.5	32.1	CIBSE TM54	

Table 8: EUI and space heating demand for the non-residential elements of the detailed part of the application

The table above demonstrates the following;-

- EUI in Blocks F and H non-residential is slightly above the GLA target of 55 kWh/m²/year as the heat supply is from the existing heat network.
- EUI in Blocks I and J non-residential is below the GLA target of 55 kWh/m²/year.
- Space heating demand in Blocks F and H non-residential is above the GLA target of 15 kWh/m²/year. A combination of measures have been used to minimise the heating demand, including triple glazing. However, small commercial and retail spaces such as these inherently have a higher form factor (when assessed separately from the rest of the building) and a higher glazing to wall ratio.
- Space heating demand in Blocks I non-residential is below the GLA target of 15 kWh/m²/year.

1.3.4 Heating Infrastructure (Be Clean)

Blocks F, H1/H2, and H3

The energy strategy (AV011) submitted as part of the original masterplan for the Aberfeldy Estate, proposed a site wide heat network served from a new energy centre sized to provide heat to all six phases of the original development.

Phases 1, 2, 3a and 3b of the original masterplan have been completed and are now occupied. The energy centre was constructed in Phase 3a and includes gas fired CHP and boilers with the capacity to serve a further 300 residential units. This has been confirmed by the operator of the network EON.

Blocks F, H1/H2, and H3 of the detailed part of the application comprise 206 residential units, and are located adjacent to Phase 3b within the area designated as phases 4 and 5 of the original masterplan.

A valved and capped connection to the existing site wide heat network has been provided at the north of Phase 3b onto Blair Street to facilitate the connection and extension to Blocks F, H1/H2, and H3 of the detailed part of the application.

GLA Energy Assessment Guidance 2022 confirms that a connection to an existing heat network must be prioritised where the CO2 emission and primary energy factors are within Part L 2021, and where the operator has agreed a decarbonisation strategy with the GLA.

Since the planning submission in October 2021, regular meetings have been held between the applicant, Meinhardt and EON (the heat network operator).

In July 2023, EON provided confirmation of the expected carbon content and primary energy factor of the heat that will be delivered to Blocks F and H using the latest SAP 10.2 carbon emission factors.

The carbon content of the heat delivered by the heat network will be 0.273 kg CO2 per kWh and the primary energy factor 1.356 kWh/kWh based on SAP10.2 carbon emission factors.

As these parameters are below the limits set out in Part L 2021 (0.350 kg CO2 per kWh for carbon content and 1.450 kWh/kWh for primary energy) and as EON have submitted a decarbonisation plan to the GLA, in accordance with GLA Energy Assessment Guidance 2022 it is therefore proposed that Blocks F and H will connect to the existing heat network.

Block I

Block I is a small block of apartments located at the very east of the application site, close to Phase 1 of the original masterplan. A future connection has not been provided to allow connection into the existing site heat network serving the original masterplan.

Due to the significant distance from the rest of the new Masterplan, and the small heating demand, it is proposed to provide heat from a block energy centre comprising air-to-water heat pumps.

The carbon reductions generated by the heat pumps are included at the Be Green stage of the hierarchy.

Block J

Block J is a row of individual terraced houses and maisonettes located at the very north of the application site.

Due to the significant distance from the rest of the new Masterplan, and the small heating demand, it is proposed to provide heat to the houses from individual air-to-water heat pumps supplemented by solar thermal, and to the maisonettes from individual MVHR heat pumps.

The carbon reductions generated by the heat pumps are included at the Be Green stage of the hierarchy.

1.3.5 Renewable Energy Systems (Be Green)

An assessment of the feasibility of including on-site renewable energy has been carried out, and the results are shown in Section 8.

Blocks F, H1/H2, and H3

It is proposed to install a total of 156 No. photovoltaic panels on the roofs with a total peak output of 59.3 kW (based on 1.72m², 22% efficient panels). The panels will generate a saving of approximately 5,248 kg CO2 per year in regulated carbon dioxide emissions.

The efficiency of each panel has been improved from 20.4% to 22% and an additional 70 No. photovoltaic panels have been included, thereby increasing the peak output from 29kW to 59.3kW since the previous submission to LBTH.

Block I

As stated above, air-to-water heat pumps are appropriate as the main heat source for Block I. The heat pumps are expected to provide a total saving of approximately 27,148 kg CO2 per year in regulated carbon dioxide emissions.

It is also proposed to install photovoltaic panels with a total peak output of 6.5 kW on the roof (based on 17 No., 1.72m², 22% efficient panels). The panels will generate a saving of approximately 537 kg CO2 per year in regulated carbon dioxide emissions.

The efficiency of each panel has been improved from 20.4% to 22% thereby increasing the peak output from 5.8kW to 6.5kW since the previous submission to LBTH.

Block J

As stated above, individual air-to-water heat pumps (supplemented by solar thermal) are appropriate as the main heat source for the houses in Block J.

It is proposed to use solar thermal panels in conjunction with the local heat pumps in each house as they can generate high temperature heat suitable for domestic hot water, thereby maximising the efficiency of the heat pumps (which are best operating at lower temperature). A collector of 1.1m² area will be provided on the roof of each house.

Individual MVHR heat pumps are appropriate as the main heat source for the maisonettes in Block J.

The heat pumps and solar thermal panels are expected to provide a total saving of approximately 16,044 kg CO2 per year in regulated carbon dioxide emissions.

It is also proposed to install photovoltaic panels with a total peak output of 16 kW on the roofs (based on 42 No., 1.72m², 22% efficient panels). The panels will generate a saving of approximately 1,327 kg CO2 per year in regulated carbon dioxide emissions.

1.3.6 Energy Monitoring (Be Seen)

The applicant confirms a commitment to monitor and report its energy performance post-construction in accordance with the 'Be Seen' guidance.

An updated 'planning stage' submission will be made via the GLA 'Be Seen' web-form immediately after the planning submission.

1.3.7 Carbon Offset

The remaining regulated carbon dioxide emissions (to 100%) over 30 years for the detailed part of the application (5,710 Tonnes CO_2) will off-set through a cash in lieu contribution of £542,455 (based on £95/Tonne) to the local planning authority, to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

1.3.8 Unregulated Energy

The energy demand and associated carbon dioxide emissions from unregulated uses, i.e. those not covered by the Building Regulations assessments (e.g. cooking, appliances, equipment) have been estimated using the following;-

- Residential – UK Government Household Electrical Survey (2014).
- Non-residential – CIBSE Guide F.

An assessment has been carried out to determine how unregulated energy and carbon dioxide emissions can be reduced through the use of energy efficient appliances and equipment, controls, good management practice, etc.

It is expected that the detailed part of the application will provide a 14.5% reduction in unregulated carbon dioxide emissions over the baseline. Refer to Section 9.

1.3.9 Overheating and Cooling

The detailed part of the application has been assessed in accordance with the cooling hierarchy detailed in policy SI 4 of the London Plan, the latest GLA Energy Assessment Guidance 2022 and Building Regulations Part O, in order to reduce overheating and minimise the use of air conditioning. Refer to Section 10.

As requested in the Energy Assessment Guidance, the Good Homes Alliance (GHA) Early Stage Overheating Risk Tool has been completed and is provided in Appendix A.7.

The assessment includes dynamic thermal modelling of the redevelopment, using IES modelling software, to assess the risk of overheating. The results are summarised below.

1.3.9.1 Residential

The residential assessment includes dynamic thermal modelling on a representative sample of dwellings to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM59 guidance, using the current 2020s summer year (DSY 1) and the more extreme DSY 2 and DSY 3 weather data.

Building Regulations Part O requires the modelling to assume that bedroom windows are closed at night if the average 8 hour ambient noise level exceeds 40 dB. The overheating risk categories assessment provided in Annex 14 of the Environment Statement Appendix: Noise and Vibration demonstrates that for most of the detailed part of the application the ambient noise levels are below 40 dB at night (identified as negligible or low risk).

The strategy will therefore generally allow for windows to be open at night in the detailed part of the application .

The overheating risk categories assessment shows that most of Block J, and parts of Blocks F and H1/H2 are subject to ambient noise levels over 40 dB at night (identified as medium or high risk) so two overheating assessments have been completed (one with windows open at night, and one with windows closed at night) to demonstrate that the passive design has been maximised.

Natural Ventilation via Openable Windows (All Blocks)

All residential dwellings tested have been modelled with natural ventilation via openable windows/doors and increased mechanical ventilation to demonstrate that passive measures have been maximised and the façade design has been optimised. The results are summarised below;-

- The CIBSE compliance criteria are met in all rooms modelled (for the 2020s DSY1 weather scenario) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.

- The CIBSE compliance criteria are met in a significant proportion of the rooms modelled (for the 2020s DSY2 and 3 weather scenarios) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.

The GLA Energy Assessment Guidance 2022 expects that the CIBSE compliance criteria is met for the DSY1 weather scenario. It is acknowledged that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files, although it is expected that in the majority of cases a significant proportion of spaces will be able to achieve compliance.

The assessment with natural ventilation demonstrates that the risk of overheating has been reduced as far as practical, with all available passive measures explored.

Closed Windows (Block J, Parts of Blocks F and H1/H2)

The overheating risk categories assessment (see Annex 14 of the Environment Statement Appendix: Noise and Vibration) shows that most of Block J, and parts of Blocks F and H1/H2 are subject to ambient noise levels over 40 dB at night (identified as medium or high risk) and therefore exceed the limit prescribed in Building Regulations Part O.

Additional modelling has been carried out for the appropriate sampled dwellings in Blocks J, F and H1/H2 with the windows closed at night but with the increased mechanical ventilation in operation. The results are summarised below;-

- The CIBSE compliance criteria cannot be met in all rooms modelled (for the 2020s DSY1 weather scenario) without blinds with closed windows/doors and increased mechanical ventilation.
- The CIBSE compliance criteria cannot be met in a significant proportion of the rooms modelled (for the 2020s DSY2 and 3 weather scenarios) without blinds with closed windows/doors and increased mechanical ventilation.

The MVHR heat pumps proposed for the maisonettes in Block J have the capability to lower the temperature of the supply air when in operation to assist in reducing the impact of high summer temperatures.

In the Block J houses and in the affected apartments in Blocks F and H1/H2, an additional cooling module would be fitted to the MVHR unit to provide the same functionality.

This would provide the occupants with an alternative method of sufficiently reducing the risk of overheating without opening the windows.

This is not considered as active cooling due to the following;-

- It would only ‘temper’ the supply air, reducing the temperature by a few degrees.
- It would have limited cooling capacity due to the size of heat pump / cooling module, and the low air volume of the residential ventilation system.
- It would not ‘control’ space temperature – it would only be used if required by the occupant and would only operate when external temperature exceeds 26 ºC at night and 28ºC during the day to achieve compliance with the CIBSE overheating criteria.
- No additional fan would be required in the apartment.

Mitigation Measures

The proposed overheating mitigation measures are summarised below;-

- In residential dwellings the use of natural ventilation via openable windows/doors and increased mechanical ventilation will generally sufficiently reduce the risk of overheating.
- In Block J and parts of Blocks F and H1/H2 where the occupants may choose to keep their windows closed at night, an alternative method of reducing the risk of overheating will be available through the use of the MVHR heat pump or a MVHR cooling module.
- During extreme summer weather, residents will be encouraged to use additional measures to reduce the risk of overheating, including the following;-
  - Using portable fans to increase airflow
  - Minimising internal heat gains
  - Keeping windows open as long as possible
- Guidance will be provided to residents on reducing the overheating risk in their home in line with the cooling hierarchy.

Non-Residential

The non-residential assessment includes dynamic thermal modelling of the non-residential space in the detailed part of the application to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM52 guidance, using the current 2020s summer year (DSY 1) and the more extreme DSY 2 and DSY 3 weather data.

The results of the dynamic modelling overheating assessment are summarised below;-

- The CIBSE compliance criteria cannot be met in the non-residential space (for the 2020s DSY1, 2 and 3 weather scenarios) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation.

The proposed overheating mitigation measures are summarised below;-

- For the retail, commercial, marketing suite and other appropriate areas active cooling is proposed.

1.4 Outline Part of the Application (Phases B, C and D)

1.4.1 Carbon Reduction Strategy

The energy strategy for the outline part of the application follows the London Plan’s updated energy hierarchy approach of ‘Be Lean’, ‘Be Clean’, ‘Be Green’, and ‘Be Seen’ as detailed in policy SI2.

The carbon emissions from the residential element of the outline part of the application have been estimated using the SAP calculation results from Block I of the detailed part of the application. These have been adjusted to reflect the proposed energy strategy for the outline part of the application (using a combination of air-to-water and water-to-water heat pumps) and then increased to reflect the maximum number of dwellings and the mix of dwelling types in the proposed outline development.

The carbon emissions from the non-residential element of the outline part of the application have been estimated using the SBEM calculation results from Blocks F and H of the detailed part of the application. These have been adjusted to reflect the proposed energy strategy for the outline part of the application (using heat pumps) and then increased pro-rata to reflect the maximum non-residential area in the proposed outline development.

1.4.2 Carbon Reductions

Domestic Carbon Emissions and Savings

The expected carbon dioxide emissions at each stage of the hierarchy are shown in the graph below for the residential element of the outline part of the application.

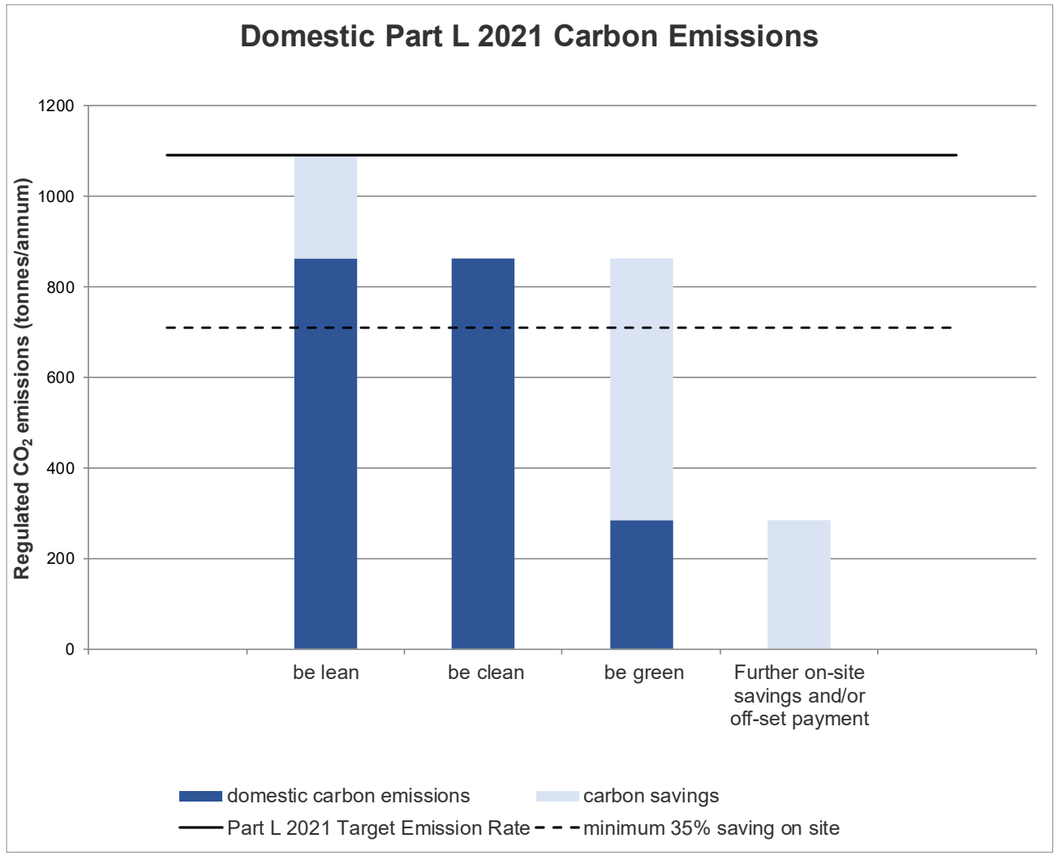


Figure 5: Domestic energy hierarchy and targets for the outline part of the application

The graph above demonstrates that the residential element of the outline part of the application is expected to significantly exceed the London Plan minimum target of 35% and GLA benchmark target of 50%, achieving an overall on-site reduction of around 74% in regulated carbon dioxide emissions over Part L 2021.

Energy demand in the residential areas will be significantly reduced, expected to exceed the GLA target of 10%, achieving a reduction of around 21% in regulated carbon emissions over Part L 2021 at the 'Be Lean' stage of the hierarchy, through passive design and energy efficiency measures alone.

The tables below detail the carbon dioxide emissions and savings expected at each stage of the energy hierarchy for the domestic elements.

	Regulated carbon dioxide emissions for domestic buildings (Tonnes CO_2 per annum)
Baseline: Part L 2021 Compliant	1,103.5
Be Lean	871.2
Be Clean	871.2
Be Green	286.0

Table 9: Carbon dioxide emissions after each stage of the energy hierarchy for domestic elements of the outline part of the application

	Regulated domestic carbon dioxide savings	
	Tonnes CO_2 per annum	**%**
Be lean	232.3	21%
Be clean	0.0	0%
Be green	585.2	53%
Cumulative on site savings	**817.5**	**74%**
Carbon shortfall	286.0	-
	Tonnes CO_2	
Cumulative savings for off-set payment	**8,581**	
Cash-in-lieu contribution	**815,201**	

Table 10: Regulated carbon dioxide savings from each stage of the energy hierarchy for domestic elements of the outline part of the application

Non-Domestic Carbon Emissions and Savings

The expected carbon dioxide emissions at each stage of the hierarchy are shown in the graph below for the non-residential element of the outline part of the application.

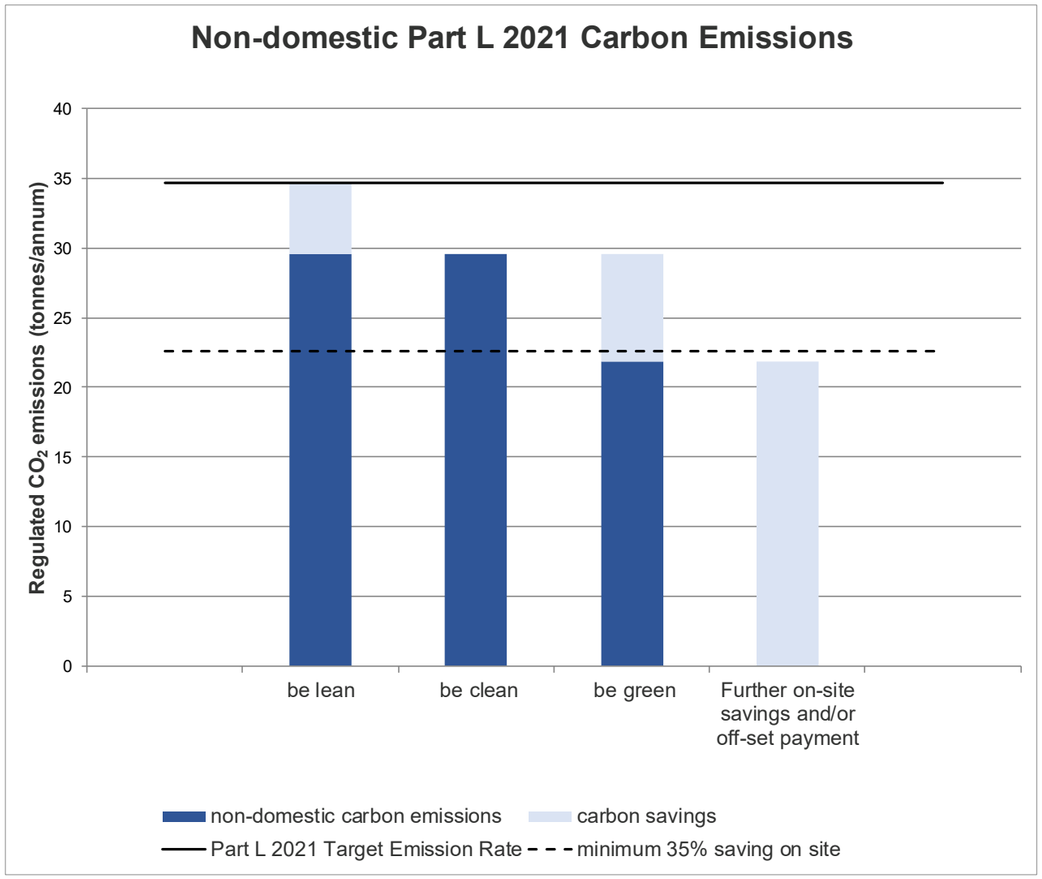


Figure 6: Non-domestic energy hierarchy and targets for the outline part of the application

The graph above demonstrates that the non-residential element of the outline part of the application is expected to exceed the London Plan minimum target of 35%, achieving an overall on-site reduction of around 37% in regulated carbon dioxide emissions over Part L 2021.

Energy demand in the non-residential areas will be significantly reduced, expected to meet the GLA target, achieving a reduction of around 15% in regulated carbon emissions over Part L 2021 at the 'Be Lean' stage of the hierarchy, through passive design and energy efficiency measures alone.

The tables below detail the carbon dioxide emissions and savings expected at each stage of the energy hierarchy for the non-domestic elements.

	Regulated carbon dioxide emissions for non-domestic buildings (Tonnes CO_2 per annum)
Baseline: Part L 2021 Compliant	35.3
Be Lean	30.1
Be Clean	30.1
Be Green	22.2

Table 11: Carbon dioxide emissions after each stage of the energy hierarchy for non-domestic elements of the outline part of the application

	Regulated domestic carbon dioxide savings	
	Tonnes CO_2 per annum	**%**
Be lean	5.1	15%
Be clean	0.0	0%
Be green	8.0	23%
Cumulative on site savings	**13.1**	**37%**
Carbon shortfall	22.2	-
	Tonnes CO_2	
Cumulative savings for off-set payment	**665**	
Cash-in-lieu contribution	**63,150**	

Table 12: Regulated carbon dioxide savings from each stage of the energy hierarchy for non-domestic elements of the outline part of the application

Total Carbon Emissions and Savings

The table below details the overall carbon dioxide emissions and savings expected at each stage of the energy hierarchy for the outline part of the application. These are calculated using SAP 10 carbon emission factors.

The table below demonstrates that the outline part of the application as a whole is expected to achieve an on-site reduction of 73% in regulated carbon dioxide emissions over Part L 2021.

	Total regulated emissions (Tonnes CO_2/year)	**CO_2 savings (Tonnes CO_2/year)**	**Percentage saving (%)**
Part L 2021 baseline	1,138.7		
Be Lean	901.4	237.4	21%
Be Clean	901.4	0.0	0%
Be Green	308.2	593.2	52%

Cumulative	-	830.5	73%
		CO_2 savings off-set (Tonnes CO_2)	
Off-set		9,245.8	

Table 13: Total regulated carbon dioxide emissions and savings for the outline part of the application

The table above demonstrates that the outline part of the application as a whole achieves an on-site reduction of 73% in regulated carbon dioxide emissions over Part L 2021.

The table above demonstrates that the total regulated carbon dioxide emissions (using Part L 2021) for the outline part of the application (308.2 Tonnes/year) are 47.5% lower than the 587.0 Tonnes/year calculated for the previous submission to LBTH.

1.4.3 Demand Reduction (Be Lean)

As detailed above, energy demand will be significantly reduced beyond Part L requirements, achieving a 21% reduction in overall carbon emissions over Part L 2021 for the outline part of the application, through passive design and energy efficiency measures alone.

The reduction is expected to be achieved by a combination of measures, which shall include the following;

- Significantly improved fabric 'U' values (including the addition of triple glazing to the commercial / retail spaces since the previous submission to LBTH);
- Minimised cold bridging (further improved since the previous submission to LBTH);
- Improved air tightness (further improved in commercial / retail spaces since the previous submission to LBTH);
- Optimised g-value of the glazing – to provide a balance between minimising heat gain in summer (to reduce overheating), maximising useful heat gain in winter (to reduce heating energy) and maximising natural daylight (to reduce lighting energy);
- Waste Water Heat Recovery (WWHR) for the residential (included since the previous submission to LBTH);
- Communal heating system to the outline development blocks;
- High efficiency ventilation systems (Residential MVHR efficiency further improved since the previous submission to LBTH);
- Minimised heat loss from heating and hot water systems;
- Low energy lighting;
- Controls systems to monitor and operate the plant and equipment as efficiently as possible; and
- Smart meters.

1.4.4 Heating Infrastructure (Be Clean)

The existing site heat network serving the original masterplan does not have capacity to serve the whole of the new Masterplan. Investigations have confirmed that there are no other district heating networks in the vicinity of this site and none planned for the near future.

It is therefore proposed to provide a new site heat network serving the heat demand of the outline part of the application (Phases B, C and D).

EON have identified potential sources of waste heat from data centres to the south of the outline part of the application, and are currently developing plans for a low temperature network that could potentially serve the outline part of the application in the future, and also be used to de-carbonise the existing heat network serving the original masterplan area.

It is therefore proposed that the site heat network serving the outline part of the application will be a low temperature network compatible with the future network being developed by EON.

As EON's plans are at an early stage, this assessment is based on the primary network for the outline part of the application being fed from central air-to-water heat pumps which will generate low temperature heat at around 20-30ºC for distribution around the development.

When available, waste heat from the EON district network could directly serve the primary network to further de-carbonise the network.

Each block will be provided with its own water-to-water heat pumps and thermal store which is used to raise the temperature to around 55°C for distribution within the block. Heat interface units will be provided per dwelling, providing instantaneous heating and hot water.

An annual heating (and cooling) load profile assessment has been carried out for the development in conjunction with a heat pump manufacturer, with demand calculated hourly using the London TRY weather data, and the results are provided in Appendix A.6. This has been used to confirm the system seasonal efficiency.

The carbon reductions generated by the heat pumps are included at the Be Green stage of the hierarchy.

1.4.5 Renewable Energy Systems (Be Green)

As stated above, air-to-water and water-to-water heat pumps are appropriate as the main heat source for the outline part of the application. The heat pumps are expected to provide a total saving of approximately 649,474 kg CO2 per year in regulated carbon dioxide emissions.

It is also proposed that photovoltaic panels will be installed on the roofs of the residential blocks in the outline part of the application.

Although the exact numbers cannot be determined at this stage, it is expected that a minimum of 420 No. photovoltaic panels will be installed on the roofs, based on a pro-rata increase from Block I. The panels will have a total peak output of 159.6 kW (based on 1.72m², 22% efficient panels). The panels will generate a saving of approximately 13,287 kg CO2 per year in regulated carbon dioxide emissions.

In accordance with GLA Energy Assessment Guidance 2022, PV provision will be maximised when the design for the Reserved Matters application(s) is developed.

1.4.6 Energy Monitoring (Be Seen)

The applicant confirms a commitment to monitor and report its energy performance post-construction in accordance with the 'Be Seen' guidance.

1.4.7 Carbon Offset

The remaining regulated carbon dioxide emissions (to 100%) over 30 years for the outline part of the application (around 9,245.8 Tonnes CO_2) will off-set through a cash in lieu contribution of approximately £878,350 (based on £95/Tonne) to the local planning authority, to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

1.4.8 Overheating and Cooling

An initial early stage assessment has been carried out for the outline part of the application in accordance with the cooling hierarchy detailed in policy SI 4 of the London Plan and the latest Energy Assessment Guidance, in order to reduce overheating and minimise the use of air conditioning.

Residential

Although dynamic thermal modelling is not a requirement for the outline part of the application, as part of the early stage design modelling has been carried out on a sample of apartments to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM59 guidance, using the current 2020s summer year (DSY 1) and the more extreme DSY 2 and DSY 3.

This modelling has been completed for a sample of west facing apartments at differing levels between the 2nd and 20th floor with both recessed and projecting balconies.

The results of this early stage dynamic modelling overheating assessment are summarised below;-

- The CIBSE compliance criteria are met in almost all rooms modelled (for the 2020s DSY1 weather scenario) for both recessed and projecting balconies, without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.
- The CIBSE compliance criteria are met in a significant proportion of the rooms modelled (for the 2020s DSY2 and 3 weather scenarios) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.

The results demonstrate that the outline design provides a suitable reduction in the risk of overheating at this stage of design.

As the design is developed for the later Reserved Matters application(s), further work will be done to explore all available passive measures with the aim of reducing the risk further.

Non-Residential

The design of the outline part of the application is not sufficiently progressed to allow dynamic thermal modelling for the non-residential areas.

As the design is developed for the later Reserved Matters application(s), an assessment will be carried out to reduce overheating and minimise the use of air conditioning in the non-residential areas.

2 Introduction

2.1 This Application

This Energy Assessment Report has been prepared by Meinhardt (UK) Ltd and is submitted in support of an updated hybrid planning application to the Mayor of London for the Aberfeldy Village Masterplan seeking detailed planning permission for Phase A and Outline planning permission for future phases, comprising:

Outline planning permission (all matters reserved) for the demolition of all existing structures and redevelopment to include a number of buildings (up to 100m AOD) and up to 140,591 (GEA) of floorspace comprising the following mix of uses: Residential (Class C3); Retail, workspace, food and drink uses (Class E); Car and cycle parking; Formation of new pedestrian route through the conversion and repurposing of the Abbott Road vehicular underpass for pedestrians and cyclists connecting to Jolly's Green; Landscaping including open spaces and public realm; and New means of access, associated infrastructure and highway works.

In Full, for residential (Class C3), retail, food and drink uses and a temporary marketing suite (Class E and Sui Generis), together with access, car and cycle parking, associated landscaping and new public realm, and open space. This application is accompanied by an Environmental Statement.

2.2 Extant Outline Planning Permission

An Outline Permission (ref: PA/11/02716/P0) was granted in June 2012 and the following has been delivered to date:

- Phases 1, 2, 3a and 3b built out
- 901 new homes
- 29% affordable homes by habitable room or 9.18% affordable homes by habitable room on the uplift
- New larger Community Centre with improved facilities
- Larger modern Health Centre
- New retail floorspace
- New energy centre
- New and enhanced high quality open space including play-space and a linear park
- Heights: 2 to 10 storeys
- Parking ratio: 0.2 spaces

2.3 This Energy Assessment

The purpose of this Energy Assessment report is to demonstrate how the climate change mitigation measures proposed for the Aberfeldy Village Masterplan address the relevant local, regional and national planning policies. It also demonstrates that energy is an integral part of the proposed development's design.

This report supersedes the Energy Assessment Report Revision P4 dated 21st October 2022 previously submitted in support of the Hybrid Application (LBTH Ref: PA/21/02377/A1 and GLA Ref: 2023/0300/S3) and should therefore be read on a standalone basis.

Following a resolution to refuse planning permission by the SDC in February 2023, and the subsequent direction that the Mayor of London will act as the local planning authority for the purposes of determining the planning application, further amendments have been made to the design of the scheme to accommodate second staircases in all buildings over 18m in height.

For the sake of completeness only it should be noted that the above referenced amendments follow previous amendments to the Hybrid Application, made prior to its consideration by the LBTH SDC, the assessments of which were set out within previous revisions of this Energy Assessment Report. In summary the previously assessed charges were: the incorporation of Jolly's Green within the red line boundary, the removal of the previously proposed Block A3 and associated increase in open space and play space, an increase in the number of affordable rented family homes, and the inclusion of second staircases in Plots F & I.

Further information is set out within the accompanying Covering Letter (as prepared by DP9 Ltd, dated November 2023) and the updated Planning Statement (as prepared by DP9 Ltd, dated November 2023).

This Energy Assessment Report has been updated to reflect the revised Building Regulations 2021 and GLA planning policy introduced since submission of the application to LBTH. Refer to Section 4.

In response to the revised Building Regulations 2021 and updated planning policy, a number of improvements have been made to the scheme to lower energy usage and carbon dioxide emissions.

2.4 Other Documents

This report should be read in conjunction with the other documents which form part of the hybrid planning application.

2.5 Project Team

Client:	EcoWorld and Poplar HARCA
Planning Consultant:	DP9
Masterplan Architect:	Levitt Bernstein
Phase A Architect:	Morris and Company
Structural, Civils, MEP, and Energy:	Meinhardt (UK) Ltd
Access Consultant:	Lord Consultants
Air Quality and Acoustics Consultant:	Entran
Arboriculture Consultant:	Arbeco
Archaeology Consultant:	Thames Valley Archaeology Services
Communications and PR:	Lowick
Cost Consultant:	Circle
Cycling Consultant:	Cycling Score
Daylight and Sunlight Consultant:	GIA
Ecology and Sustainability Consultant:	Greengage
Education Consultant:	Quod
EIA Consultant:	Trium
Fire Consultant:	Elementa
Flood Risk Consultant:	Parmabrook
Heritage Consultant:	KM Heritage
Landscape Architect:	LDA Design
Legal:	Pinsent Masons
Play and Recreation:	ZCD Architects
Principal Designer:	Baily Garner
Retail and Commercial Consultant:	AND

Rights of Light Consultant:	Anstey Horne
Socio-Economic Consultant:	Hatch
Townscape Consultant:	Peter Stewart Consultancy
Transport Consultant:	Velocity
Viability Consultant:	DS2
Visual Impact Assessment:	Miller Hare
Visualisation:	Black Point Design
Wind Consultant:	RWDI

3 Scheme Overview

3.1 Site and Surroundings

The Site is located in Poplar, within the administrative boundary of the London Borough of Tower Hamlets. The Site is 9.08 hectares in total and comprises:

- Abbott Road;
- Aberfeldy Street;
- Balmore Close;
- Blairegowrie House;
- Heather House;
- Jura House;
- Tartan House;
- Thistle House;
- Kilbrennan House;
- Blairgowrie House;
- Nos. 33-35 Findhorn Street;
- 2a Ettrick Street;
- Lochnager Street;
- Aberfeldy Neighbourhood Centre;
- Nairn Street Estate; and
- Leven Road Open Space, Jolly's Green and Braithwaite Park.

Figure 7: Aerial view of the existing site

3.2 Proposed Development

An outline planning approval was granted for the Aberfeldy Estate masterplan in 2012. Phases 1, 2, 3a and 3b of the original masterplan have been completed on site and are now occupied.

The New Aberfeldy Masterplan includes the residual phases of the original masterplan (phase 4-6), the Nairn Street Estate to the north, Abbott Road, the properties and land around Balmore Close and the existing green space along Abbott Road: Millennium Green, Jolly's Green, Braithwaite Park and the Leven Road green amenity space.

The proposed scheme will include the phased demolition of all existing buildings and structures, site preparation works and the construction of a new mixed use redevelopment, including the following;-

- Residential
- Retail
- Workspace/ employment space
- Resident facilities
- Temporary marketing suite

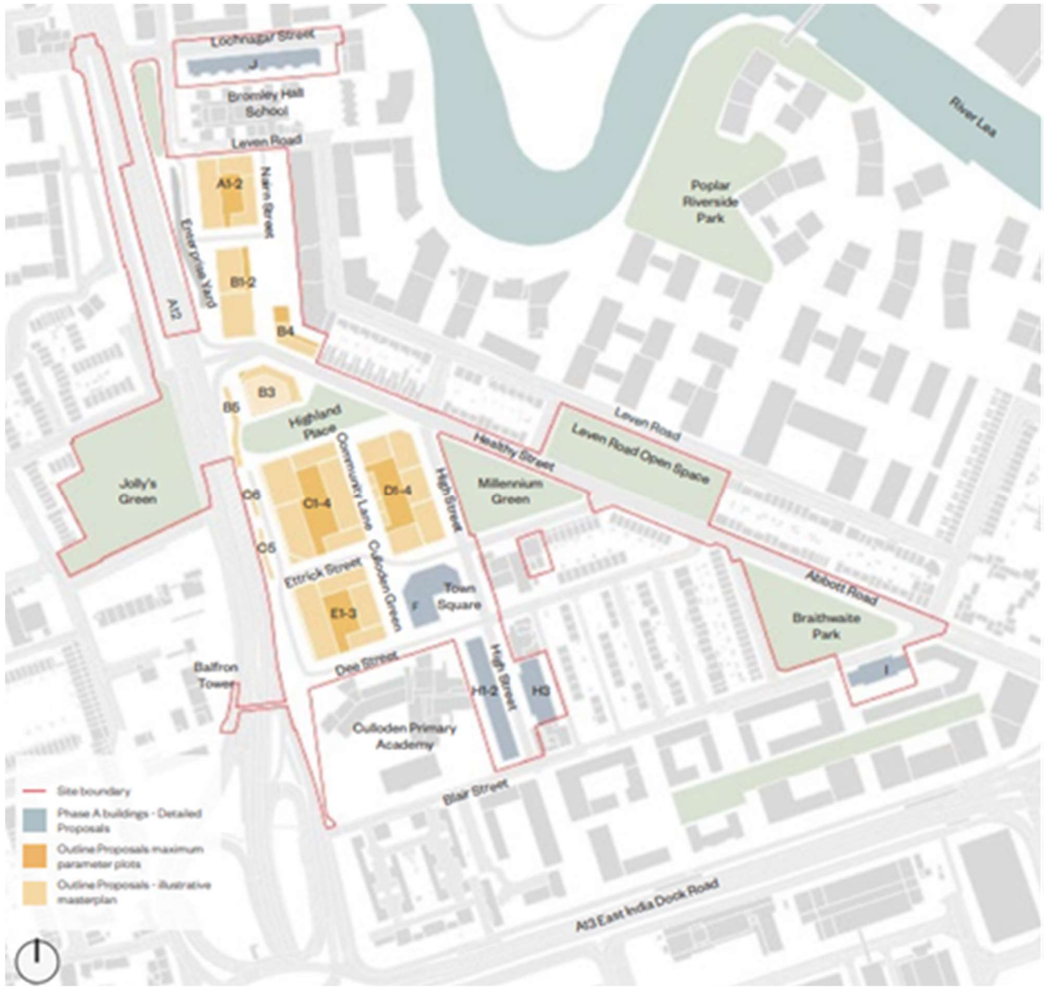


Figure 8: Plan view of the illustrative Aberfeldy Village Masterplan

The detailed part of the application comprises Phase A of the proposed development located in the areas shown in grey below, and includes Blocks F, H1/H2, H3, I and J.

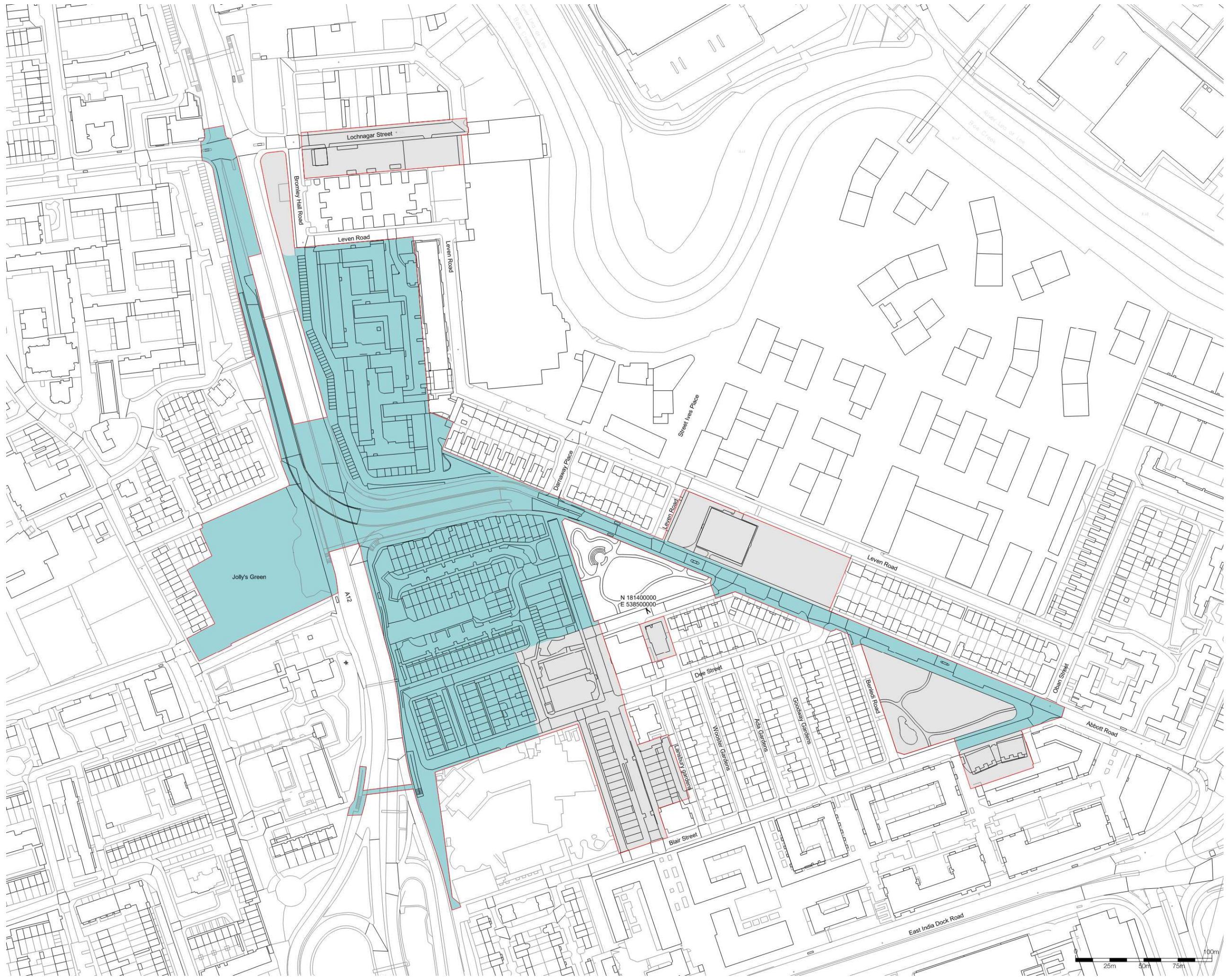


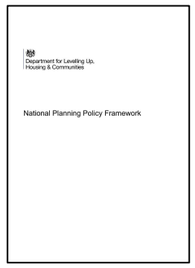
Figure 9: Detailed part of the application Phase A location plan

The remainder of the Aberfeldy Village Masterplan forms the outline part of the application and is expected to be constructed in a further three phases (B, C and D) as shown on Figure 8 above.

4 Planning Policy

4.1 National

4.1.1 National Planning Policy Framework (2023)



The National Planning Policy Framework (NPPF) set out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced.

The current version was issued in September 2023.

4.1.2 Building Regulations

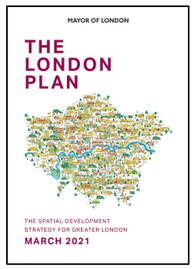
The Building Regulations set out the statutory standards that developments are to meet. These standards cover measures including energy efficiency, water efficiency, sound resistance and ventilation.

Part L of the Building Regulations covers energy efficiency requirements.

The current version of Part L was issued in 2021 (with minor amendments in 2023).

4.2 Regional

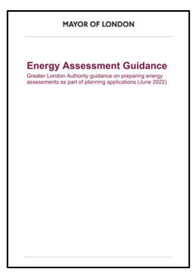
4.2.1 The London Plan (2021)



The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth.

The Plan is part of the statutory development plan for London, meaning that the policies in the Plan should inform decisions on planning applications across the capital. Borough's Local Plans must be in 'general conformity' with the London Plan, ensuring that the planning system for London operates in a joined-up way and reflects the overall strategy for how London can develop sustainably.

4.2.2 Energy Assessment Guidance (2022)

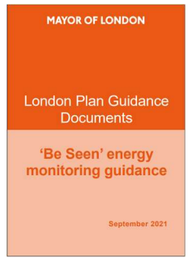


This guidance document explains how to prepare an energy assessment to accompany strategic planning applications referred to the Mayor.

The purpose of an energy assessment is to demonstrate that the proposed climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy.

An updated version was published in June 2022 which explains how London Plan policies apply now that Part L 2021 has taken effect.

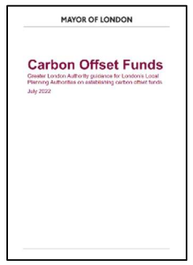
4.2.3 'Be Seen' Energy Monitoring Guidance (2021)



This guidance explains the process that needs to be followed to comply with the 'Be Seen' post-construction monitoring requirement of Policy SI 2 of the new London Plan.

The collected data will help the GLA and local authorities better understand how London Plan policies are being applied to new developments, it will provide useful insights to the performance gap and will drive improved building performance.

4.2.4 Carbon Offset Funds (2022)



This guidance document provides further detail for London's LPAs on setting up carbon offset funds and identifying suitable projects to best utilise that funding. It aims to encourage a consistent approach across London but one that allows for flexibility according to an LPA's local context and priorities

5 Establishing Energy Demand and Emissions

5.1 Carbon Reduction Targets

5.1.1 National Policy

The UK Government has made a commitment to bring all greenhouse gas emissions in the UK to net zero by 2050. Further commitments have been made to reducing economy-wide greenhouse gas emissions by at least 68% by 2030 and by 78% by 2035, compared to 1990 levels.

5.1.2 Building Regulations

An updated Building Regulations Part L Conservation of Fuel and Power and a new Part O Overheating were introduced in June 2022. The updated Part L is expected to deliver a 30% improvement on 2013 standards for domestic buildings.

Further consultation is expected on the new Future Homes Standard and Future Buildings Standard which are intended to be introduced in 2025.

5.1.3 London Plan (2021)

Major development should be net zero-carbon, with a minimum on-site reduction of at least 35 per cent beyond Building Regulations Part L 2013 requirements.

Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent reduction through energy efficiency measures.

Where the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, either through a cash in lieu contribution to the borough's carbon offset fund, or off-site provided that an alternative proposal is identified and delivery is certain.

Carbon emissions from any other part of the development i.e. unregulated emissions, should be calculated and minimised.

5.1.4 Energy Assessment Guidance (2022)

Updated planning guidance has been published by the GLA (in June 2022) which explains how London Plan policies apply now that Part L 2021 has taken effect.

Residential developments are expected to be able to exceed the 35 per cent minimum improvement over Building Regulations Part L 2021 requirements and should aim to achieve at least a 50 per cent improvement.

5.2 Detailed Part of the Application

5.2.1 Residential

5.2.1.1 Methodology

Building Regulations Part L1 2021 SAP calculations have been undertaken, using Elmhurst Design SAP10.2 software for a sample of residential dwellings in each block.

The calculations include apartments at the lowest level, intermediate and top floors.

The results of the residential SAP calculations (Compliance and TER/DER worksheets) are provided in Appendix A.1 for the 'Be Lean' stage of the hierarchy and in Appendix A.2 and for the 'Be Green' stage.

5.2.1.2 Baseline Emissions

In accordance with GLA Energy Assessment Guidance 2022, to determine the CO_2 emissions baseline the Target Emission Rate (TER) has been used from the final proposed building specification ie the 'Be Green' stage of the hierarchy.

The SAP 10.2 TER includes an area of photovoltaic panels in accordance with the dwelling floor area and the number of storeys in the block (for flats).

The GLA Carbon Emissions Reporting spreadsheet also includes the carbon savings generated by the notional PV panels for the actual building, at both the 'Be Lean' and 'Be Clean' stages of the hierarchy (but not at the 'Be Green' stage) to ensure that passive design and energy efficiency savings are suitably demonstrated.

Blocks F and H

As the final proposed building specification includes a connection to an existing heat network, SAP 10.2 calculates the TER using a heat network with the same carbon emission and primary energy factors as used in calculating the DER for the actual building.

Blocks I and J

As the final proposed building specification includes heat pumps, SAP 10.2 calculates the TER using a gas fired boiler with an efficiency of 89.5% for space heating and hot water.

5.2.2 Commercial

5.2.2.1 Methodology

Building Regulations Part L2 2021 modelling has been undertaken for the commercial area using IES dynamic thermal modelling software (SBEM) in line with the relevant National Calculation Methodology (NCM) guidance.

The BRUKL output sheets are provided in Appendix A.3 for the 'Be Lean' stage of the hierarchy and in Appendix A.4 and for the 'Be Green' stage.

5.2.2.2 Baseline Emissions

In accordance with GLA Energy Assessment Guidance 2022, to determine the CO_2 emissions baseline the Target Emission Rate (TER) has been used from the final proposed building specification ie the 'Be Green' stage of the hierarchy.

The SBEM TER normally includes an area of photovoltaic panels in accordance with the building area and arrangement, but for this development it is proposed to supply 100% of the space heating and hot water demand from heat pumps so the area of PV in the TER is reduced to zero.

The GLA Carbon Emissions Reporting spreadsheet also includes the carbon savings generated by the notional PV panels for the actual building, at both the 'Be Lean' and 'Be Clean' stages of the hierarchy (but not at the 'Be Green' stage)

Blocks F and H

As the final proposed building specification includes a connection to an existing heat network, SBEM calculates the TER using a heat network with the same carbon emission and primary energy factors as used in calculating the BER for the actual building.

Blocks I

As the final proposed building specification includes heat pumps, SBEM calculates the TER using a heat pump with a seasonal efficiency of 2.64 for space heating and 2.86 for hot water.

5.3 Outline Part of the Application

5.3.1 Residential

The carbon emissions from the residential element of the outline part of the application have been estimated using the SAP calculation results from Block I of the detailed part of the application.

These have been adjusted to reflect the proposed energy strategy for the outline part of the application (using a combination of air-to-water and water-to-water heat pumps) and then increased to reflect the maximum number of dwellings and the mix of dwelling types in the proposed outline development.

5.3.2 Non-Residential

The carbon emissions from the non-residential element of the outline part of the application have been estimated using the SBEM calculation results from Blocks F and H of the detailed part of the application.

These have been adjusted to reflect the proposed energy strategy for the outline part of the application (using heat pumps) and then increased pro-rata to reflect the maximum non-residential area in the proposed outline development.

6 Demand Reduction (Be Lean)

6.1 Detailed Part of the Application

Energy demand will be significantly reduced beyond Part L requirements, achieving a 16% reduction in overall carbon emissions over Part L 2021 for the detailed part of the application, through passive design and energy efficiency measures alone.

The demand reduction will be achieved by a combination of the measures including those detailed below;-

6.1.1 Building Fabric Insulation

The thermal performance of the building fabric will be significantly improved over Part L 2021 minimum requirements as below;-

Fabric Element	Blocks F, H and I Residential 'U' Values (W/m² K)	Block J Residential 'U' Values (W/m² K)	Non-Residential 'U' Values (W/m² K)
External Walls	0.14	0.13	0.14
Floor	0.10	0.08	0.10
Roof	0.10	0.10	0.10
Windows	1.3	0.80	0.8 (Block F and H retail and Office areas), 1.40

Table 14: Proposed fabric 'U' values for the detailed part of the application

The window U value has been further improved in the commercial / retail space, from 1.4 W/m² K used in the previous submission to LBTH, through the incorporation of triple glazing.

6.1.2 Cold Bridging

Thermal bridging will be minimised to reduce the loss of heat and to prevent the development of cold spots which can lead to mould.

At this early stage of design, detailed construction joint drawings are not available, so each junction type has been assessed and a target improved psi-value has been set as detailed below.

These targets have been benchmarked against calculations from other similar junctions and reputable sources such as the LABC, to ensure they are deliverable.

At the appropriate stages of design and construction, the thermal bridges will be demonstrated to the Building Control Body in accordance with the requirements of Building Regulations Part L 2021.

Residential

The target improved psi-values have been set using the reference values detailed in Table R2 of the SAP 10.2 Procedure, except for window junctions (E2, E3 and E4) which have used an improved psi value of 0.03. The y-value is calculated individually for each dwelling in the SAP software using the measured junction lengths.

Commercial

IES VE software calculates thermal bridge heat losses for the actual building using default y-values that are 25% of the construction element 'U' values, in accordance with the NCM Modelling Guide.

The target improved y-values have been set at 10% of the construction element 'U' values, in accordance with the notional building in the NCM Modelling Guide.

6.1.3 Air Tightness

The target air permeability has been set at 2.5 $m^3/(h\ m^2)$ in non-residential areas and 3 $m^3/(h\ m^2)$ in the residential dwellings, as compared to the Part L minimum requirement of 8 $m^3/(h\ m^2)$ to reduce heat loss in winter.

The air permeability has been further improved in the commercial / retail space from 3 $m^3/(h\ m^2)$ used in the previous submission to LBTH.

6.1.4 Natural Daylight

Natural daylight has been maximised wherever possible in the residential accommodation by arranging the living rooms and bedrooms as shallow spaces on the perimeter, by providing dual aspect glazing where possible, and by ensuring ceiling voids are as small as possible (particularly at the perimeter) to maintain the maximum floor to ceiling heights.

Increased floor to ceiling heights with full height glazing are generally provided to the ground floor commercial units and residential entrances.

6.1.5 Solar Gain

The size and g-value of the glazing has been optimised using the SAP calculations, SBEM calculations and the dynamic thermal modelling for the overheating assessment, in order to provide a balance between minimising summer heat gain to prevent overheating, maximising winter heat gain to reduce heating loads, and maximising natural daylight to reduce lighting energy.

This has resulted in the g-value of the glazing being set as detailed below;-.

Space type	Glazing g-value
Blocks F, H and I	0.33
Block J	0.50
Non-residential	0.33

Table 15: Glazing g-values for the detailed part of the application

6.1.6 Shading

Balconies are provided to most of the proposed development which will provide a shading effect to the residential apartments to minimise peak solar gain.

6.1.7 Waste Water Heat Recovery (WWHR)

WWHR will be included for the showers in the residential dwellings, based on a utilisation factor of 0.902. This has been included since the previous submission to LBTH.

6.1.8 Heating Systems

In Section 7.9 entitled "Heating and hot water assumptions" the GLA Energy Assessment Guidance 2022 states "*For the purposes of demonstrating CO2 emission improvements in the 'be lean' stage of the energy hierarchy, applicants should use the notional building system type and performance values specified in the Part L 2021 baseline as determined by the final proposed building specification*".

Blocks F and H – Residential and Non-Residential

In SAP 10.2 and SBEM where a connection to an existing heat network is proposed as the final specification, the notional building uses a heat network with the same carbon emission and primary energy factors as used in calculating the DER/BER for the actual building.

In July 2023, EON confirmed that the carbon content of the heat delivered by the heat network will be 0.273 kg CO2 per kWh and the primary energy factor 1.356 kWh/kWh based on SAP10.2 carbon emission factors, so this has also been used for the actual building in the Block F and H non-residential SBEM calculations at 'Be Lean' stage.

The residential SAP calculations for Blocks F and H use the following input parameters at 'Be Lean' stage to reflect the confirmed carbon content of the heat network;-

Input parameter	Value
CHP heat efficiency	49.9%
CHP electrical efficiency	32.0%
CHP fraction	55.8%
Boiler efficiency	93.9%
Boiler fraction	44.2%
Distribution loss factor	1.25

Table 16: SAP heating system input parameters for Blocks F and H

Blocks I and J – Residential

In SAP 10.2 where heat pumps are proposed as the final specification, the notional building uses a gas fired boiler with an efficiency of 89.5% for space heating and hot water, so this has also been assumed for the actual building at 'Be Lean' stage for Blocks I and J residential dwellings.

Block I – Non-Residential

In SBEM where heat pumps are proposed as the final specification, the notional building uses a heat pump with a seasonal efficiency of 2.64 for space heating and 2.86 for hot water, so this has also been assumed for the actual building at 'Be Lean' stage for Block I non-residential areas.

6.1.9 Pipework Heat Losses

The site heating systems will be designed to minimise heat losses in accordance with the recommendations of CIBSE CP1, including measures such as minimising pipework lengths and installing high level of insulation (in excess of British Standards).

6.1.10 Cooling

Residential

Active mechanical cooling is not proposed for the residential dwellings.

The use of natural ventilation via openable windows/doors and increased mechanical ventilation will generally sufficiently reduce the risk of overheating.

In Block J, where the occupants may choose to keep their windows closed at night, an alternative method of reducing the risk of overheating will be available through the use of the MVHR heat pump or a MVHR cooling module.

Non-Residential

For the retail units, marketing suite, and other appropriate areas active cooling is proposed via cooling only split or multi-split heat pump systems which will achieve a seasonal efficiency of 3.92.

6.1.11 Ventilation Systems

Residential

Ventilation to the residential apartments to provide fresh air and extract moisture/pollutants in accordance with Building Regulations Part F will be via individual Mechanical Ventilation with Heat Recovery (MHVR) units. Each unit will achieve a Specific Fan Power of up to 0.47 W/(l/s) and a heat recovery efficiency of up to 91%, depending on the number of wet rooms.

This has been further improved from 0.52 W/(l/s) and 90% efficiency used in the previous submission to LBTH, through the selection of an alternative newer model.

The communal corridors shall have a dual purpose mechanical extract system that can operate to assist the natural ventilation when necessary in maintaining air movement in corridors and prevent stagnant air and odour build up in winter.

Non-Residential

It is expected that the retail units, marketing suite, and other appropriate areas will be provided with local commercial MVHR units that will achieve a Specific Fan Power of less than 1.1 W/(l/s) and a heat recovery efficiency of at least 85%.

6.1.12 Lighting

Energy efficient LED lighting will be used throughout the proposed development. Occupancy and daylight sensors will be used where appropriate.

6.1.13 Smart Controls / Metering

It is expected that residential apartments will be provided with an individual, programmable, zoned, control system, together with smart energy meters.

This will allow the display of energy use within individual units, assisting occupants to understand the way in which they consume energy and how much it costs, and encouraging them to turn off non-essential equipment or run some equipment at a lower capacity during times of peak demand.

A central Building Management System (BMS) will be provided to operate the 'Landlord' plant and systems in the most energy efficient manner.

6.1.14 Appliances

Where appliances are provided by the developer they will be of an energy efficient type, which generally generate less heat and can help minimise the build-up of heat within the buildings. Where appliances are not provided by the developer, owners/tenants will be encouraged to supply energy efficient equipment.

6.2 Outline Part of the Application

Detailed energy assessments will be carried out as part of the Reserved Matters application(s) to determine the most appropriate demand reduction measures.

The below sections outline the measures incorporated in the outline part of the application, which should form the minimum standards expected to be achieved for all areas within the masterplan.

6.2.1 Building Fabric Insulation

The thermal performance of the building fabric should achieve at least the following;-

Fabric Element	Residential 'U' Values (W/m^2 K)	Non-Residential 'U' Values (W/m^2 K)
External Walls	0.14	0.14
Floor	0.10	0.10
Roof	0.10	0.10
Windows	1.30	0.8 in retail and office areas, 1.40 elsewhere

Table 17: Proposed maximum fabric 'U' values for the outline part of the application

The window U value has been further improved in the commercial / retail space, from 1.4 W/m² K used in the previous submission to LBTH, through the incorporation of triple glazing.

6.2.2 Cold Bridging

Cold bridging should be minimised to prevent the loss of heat and to prevent the development of cold spots, which can lead to mould. Suitable construction details should be developed to ensure insulation continuity and to meet the air tightness targets detailed below.

6.2.3 Air Tightness

The target air permeability should be set at a maximum of 2.5 $m^3/(h\ m^2)$ in non-residential areas and 3 $m^3/(h\ m^2)$ in the residential dwellings.

The air permeability has been further improved in the commercial / retail space from 3 $m^3/(h\ m^2)$ used in the previous submission to LBTH.

6.2.4 Daylight and Solar Gain

The size and g-value of the glazing should be optimised using SAP calculations, SBEM calculations and dynamic overheating modelling, in order to provide a balance between minimising summer heat gain to prevent overheating, maximising winter heat gain to reduce heating loads, and maximising natural daylight to reduce lighting energy.

6.2.5 Shading

External shading should be considered as appropriate to reduce peak solar gain.

6.2.6 Waste Water Heat Recovery (WWHR)

WWHR should be included for the showers in the residential dwellings, with a minimum utilisation factor of 0.902. This has been included since the previous submission to LBTH.

6.2.7 Heating and Hot Water System

Residential

In SAP 10.2 where heat pumps are proposed as the final specification, the notional building uses a gas fired boiler with an efficiency of 89.5% for space heating and hot water, so this should also be assumed for the actual building at 'Be Lean' stage.

Non-Residential

In SBEM where heat pumps are proposed as the final specification, the notional building uses a heat pump with a seasonal efficiency of 2.64 for space heating and 2.86 for hot water, so this should also be assumed for the actual building at 'Be Lean' stage.

6.2.8 Pipework Heat Losses

The site heating systems should be designed to minimise heat losses in accordance with the recommendations of CIBSE CP1, including measures such as minimising pipework lengths and installing high level of insulation (in excess of British Standards).

6.2.9 Cooling

Residential

Active mechanical cooling should not be proposed for the residential dwellings.

The use of natural ventilation via openable windows/doors and increased mechanical ventilation should generally sufficiently reduce the risk of overheating.

Where the occupants may choose to keep their windows closed at night due to higher external noise levels, an alternative method of reducing the risk of overheating should be made available through the use of MVHR heat pumps or a MVHR cooling module.

Non-Residential

For the workspace and retail units cooling is expected to be provided via VRF, split or multi-split heat pump systems which should achieve a seasonal efficiency of at least 3.92.

6.2.10 Ventilation Systems

Residential

Ventilation to the residential apartments should be via individual Mechanical Ventilation with Heat Recovery (MHVR) units. Each unit should achieve a Specific Fan Power of up to 0.47 W/(l/s) and a heat recovery efficiency of up to 91%, depending on the number of wet rooms.

This has been further improved from 0.52 W/(l/s) and 90% efficiency used in the previous submission to LBTH, through the selection of an alternative newer model.

The communal corridors shall have a dual purpose mechanical extract system that can operate to assist the natural ventilation when necessary in maintaining air movement in corridors and prevent stagnant air and odour build up in winter.

Non-Residential

It is expected that the workspace and retail units will be provided with local commercial MVHR units that should achieve a Specific Fan Power of less than 1.1 W/(l/s) and a heat recovery efficiency of at least 85%.

6.2.11 Lighting

Energy efficient LED lighting should be used throughout the proposed development. Occupancy and daylight sensors should be used where appropriate.

6.2.12 Smart Controls / Metering

It is expected that residential apartments will be provided with an individual, programmable, zoned, control system, together with smart energy meters.

A central Building Management System (BMS) should be provided to operate the ‘Landlord’ plant and systems in the most energy efficient manner.

6.2.13 Appliances

Where appliances are provided by the developer they should be of an energy efficient type, and where they are not provided by the developer, owners/tenants will be encouraged to supply energy efficient equipment.

7 Heating Infrastructure (Be Clean)

7.1 Detailed Part of the Application

7.1.1 Blocks F, H1/H2, and H3

Overview

The energy strategy (AV011) submitted as part of the original masterplan for the Aberfeldy Estate, proposed a site wide heat network served from a new energy centre sized to provide heat to all six phases of the development.

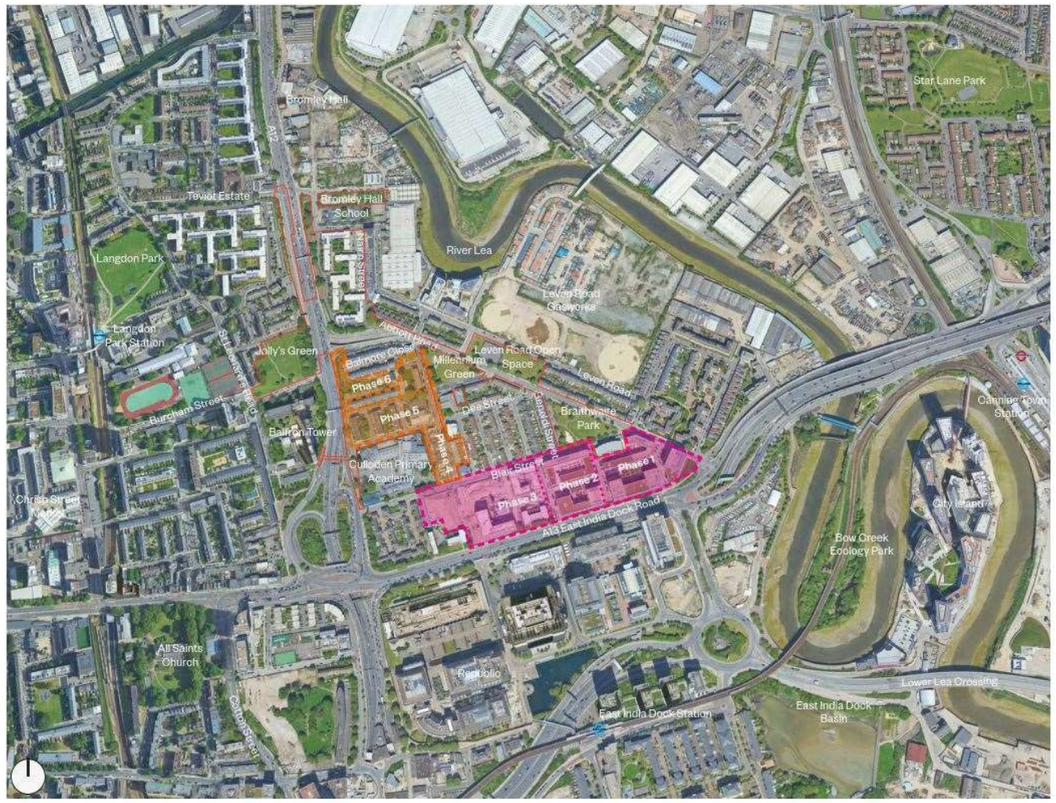


Figure 10: Aerial view of the original masterplan phases and the new masterplan boundary

Phases 1, 2, 3a and 3b of the original masterplan have been completed on site and are now occupied. The energy centre was constructed in Phase 3a and includes gas fired CHP and boilers with the capacity to serve a further 300 residential units. This has been confirmed by the operator of the network Eon.

Blocks F, H1/H2, and H3 of the detailed part of the application comprise 206 residential units, and are located adjacent to Phase 3b within the area designated as phases 4 and 5 of the original masterplan.

A valved and capped connection to the existing site wide heat network has been provided at the north of Phase 3b onto Blair Street to facilitate the connection and extension to Blocks F, H1/H2, and H3 of the detailed part of the application.

GLA Energy Assessment Guidance 2022 confirms that a connection to an existing heat network must be prioritised where the CO2 emission and primary energy factors are within Part L 2021, and where the operator has agreed a decarbonisation strategy with the GLA.

Since the planning submission in October 2021, regular meetings have been held between the applicant, Meinhardt and EON (the heat network operator).

In July 2023, EON provided confirmation of the expected carbon content and primary energy factor of the heat that will be delivered to Blocks F and H using the latest SAP 10.2 carbon emission factors. The carbon content of the heat delivered by the heat network will be 0.273 kg CO2 per kWh and the primary energy factor 1.356 kWh/kWh based on SAP10.2 carbon emission factors.

As these parameters are below the limits set out in Part L 2021 (0.350 kg CO2 per kWh for carbon content and 1.450 kWh/kWh for primary energy) and as EON have submitted a decarbonisation plan to the GLA, in accordance with GLA policy it is therefore proposed that Blocks F and H will connect to the existing heat network.

Connection to the Network

The primary pipework will be extended from the valved and capped connection in Blair Street to heat substations in Blocks F and H3, which will act as a hydraulic break between the primary network and the secondary heating system that distributes heat throughout the building.

Each substation will consist of two equally sized heat exchangers providing 60% of the heat demand. The substation will operate with both heat exchangers operating in parallel at all times unless a fault in one requires isolation.

Existing Energy Centre

The existing energy centre has been constructed on the ground floor level of Block H and includes a low NOx gas fired “base thermal” load Combined Heat and Power CHP unit operating in conjunction with a supplementary gas fired boiler plant and thermal storage.

The CHP unit has the following specification;-

Heat output	357kW	49.9% gross efficiency
Electrical output	229kW	32.0% gross efficiency
Gas input (gross)	716kW	

The gas fired boilers have a total output of 5020 kW and a gross seasonal efficiency of 93.9%. The centralised thermal storage vessels have a total capacity of approximately 40,000 litres at 85°C storage temperature.

In July 2023, EON confirmed the CHP fraction at 55.8%, which is improved from 51% used in the previous submission to LBTH.

For the SAP calculations a distribution loss factor of 1.25 has been used to reflect the carbon content of 0.273 kg CO2 per kWh confirmed by EON.

7.1.2 Block I

Block I is a small block of apartments located at the very east of the application site, close to Phase 1 of the original masterplan. A future connection has not been provided to allow connection into the existing site heat network serving the original masterplan.

Due to the significant distance from the rest of the new Masterplan, and the small heating demand, it is proposed to provide heat from a block energy centre comprising air-to-water heat pumps and water-to-water heat pumps.

A load assessment has been carried out for Block I by a heat pump manufacturer, which confirms a seasonal efficiency of 310% is achievable for the block heat pumps with appropriate thermal storage. This is improved from the 257% used in the previous submission to LBTH. Please refer to Appendix A.5.

For the SAP calculations a distribution loss factor of 1.1 has been used, as it is a small building wide system.

The carbon reductions generated by the heat pumps are included at the Be Green stage of the hierarchy.

7.1.3 Block J

Block J is a row of individual terraced houses and maisonettes located at the very north of the application site.

Due to the distance from the rest of the new Masterplan, and the small heating demand, it is proposed to provide heat to the houses from individual air-to-water heat pumps supplemented by solar thermal, and to the maisonettes from individual MVHR heat pumps.

Houses

Each system will comprise of an inverter driven outdoor unit and a wall mounted indoor unit, together with a hot water storage vessel.

It is proposed to use solar thermal panels in conjunction with the local heat pumps in each house as they can generate high temperature heat suitable for domestic hot water, thereby maximising the efficiency of the heat pumps (which are best operating at lower temperature).

When selected in the SAP Database, the proposed unit for the houses (Mitsubishi Ecodan PUZ-WMA5VAA) achieves a space heating efficiency of up to 100%, and a domestic hot water efficiency of 267%.

The carbon reductions generated by the heat pumps are included at the Be Green stage of the hierarchy.

Maisonettes

Each individual MVHR heat pump comprises an electric heat pump, hot water vessel and MVHR unit with counterflow heat exchanger.

The unit provides the following;-

- Supply and extract ventilation to the dwelling, with heat recovery via the integral counterflow heat exchanger
- Domestic hot water via the integral hot water storage vessel
- Space heating via the ventilation supply air
- Cooling (tempering) of the ventilation supply air

It is proposed to use the Nilan Compact P heat pump for the maisonettes, which is a Passivhaus Certified product. However, when selected in the SAP Database, the Elmhurst software is unable to calculate, so a seasonal efficiency of 310% has been assumed.

The carbon reductions generated by the heat pumps are included at the Be Green stage of the hierarchy.

7.2 Outline Part of the Application

The existing site heat network serving the original masterplan does not have capacity to serve the whole of the new Masterplan. Investigations have confirmed that there are no other district heating networks in the vicinity of this site and none planned for the near future.

It is therefore proposed to provide a new site heat network serving the heat demand of the outline part of the application (Phases B, C and D).

EON have identified potential sources of waste heat from data centres to the south of the outline part of the application, and are currently developing plans for a low temperature network that could potentially serve the outline part of the application in the future, and also be used to de-carbonise the existing heat network serving the original masterplan area.

It is therefore proposed that the site heat network serving the outline part of the application will be a low temperature network compatible with the future network being developed by EON.

As EON's plans are at an early stage, this assessment is based on the primary network for the outline part of the application being fed from central air-to-water heat pumps which will generate low temperature heat at around 20-30ºC for distribution around the development.

When available, waste heat from the EON district network could directly serve the primary network to further de-carbonise the network.

Each block will be provided with its own water-to-water heat pumps and thermal store which is used to raise the temperature to around 55°C for distribution within the block. Heat interface units will be provided per dwelling, providing instantaneous heating and hot water.

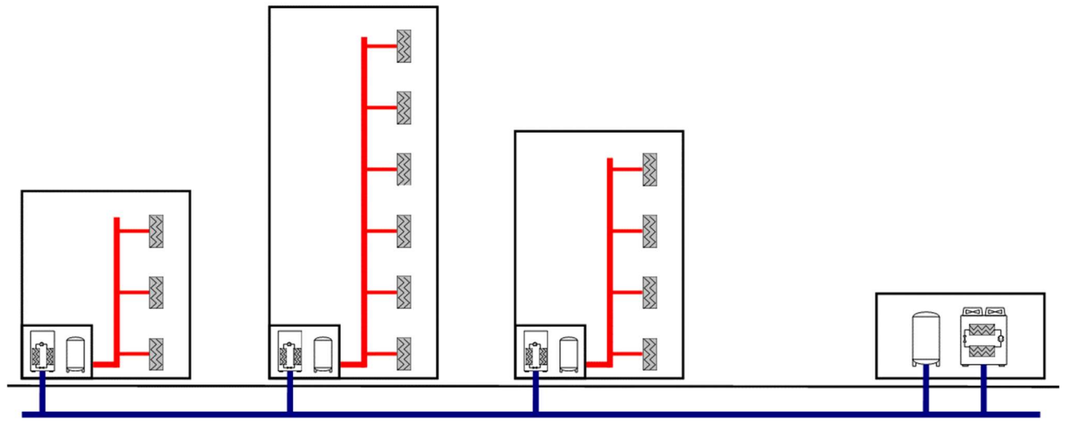


Figure 11: Diagrammatic of the proposed heat pump arrangement for the outline part of the application

An annual heating (and cooling) load profile assessment has been carried out for the development in conjunction with a heat pump manufacturer, with demand calculated hourly using the London TRY weather data, and the results are provided in Appendix A.6. This has been used to confirm the system seasonal efficiency.

The load profile assessment demonstrates an overall seasonal efficiency of 257% for the combination of the central and block heat pumps (in heating mode). For the SAP calculations a distribution loss factor of 1.2 has been assumed.

The site heat network within the development will be designed in accordance with CIBSE CP1 Heat Networks: Code of Practice.

The development has been arranged into several blocks, with the cores located centrally in each block to minimise lateral pipe runs and hence heat losses.

The system will operate with a variable volume and maximum temperature to satisfy the requirements of the tertiary system, which delivers the heat demand to the occupied spaces.

A high level of insulation (in excess of British Standards) will be provided to all parts of the systems, in accordance with the recommendations of CIBSE CP1.

The site heat network will have the following provisions to allow connection to either a future district heating network or a waste heat source (such as the data centre);-

- Space for future district heating interfacing heat exchanger, pumps, controls etc;
- Provision to allow future district heating connecting pipework to be routed through from outside; and
- Spare ways on local electrical distribution boards for future electrical supplies to pumps, controls etc.

8 Renewable Energy (Be Green)

8.1 Detailed Part of the Application

An appraisal of potential on-site renewable energy systems has been undertaken for the development with the following technologies considered:

- Biomass boilers;
- Photovoltaics (PVs);
- Solar thermal;
- Ground source heat pumps;
- Air source heat pumps; and
- Wind Turbines.

8.1.1 Biomass Boilers

Biomass boilers could provide a proportion of the space heating and hot water load, but would compete with the existing CHP serving the base load of the detailed part of the application.

Biomass boilers are better operating as the lead heat source (and not as top up) as they are not suited to operating with variable load.

Biomass boilers would also adversely impact on local air quality due to their emissions, and vehicular delivery of fuel would be required resulting in increased traffic movements.

Biomass boilers are therefore not proposed for the development.

8.1.2 Photovoltaics (PVs)

An assessment has been carried out and it has been determined that photovoltaic panels are appropriate for the detailed part of the application as detailed below.

Blocks F, H1/H2, and H3

It is proposed to install a total of 156 No. photovoltaic panels on the roofs with a total peak output of 59.3 kW (based on 1.72m², 22% efficient panels). The panels will generate a saving of approximately 5,248 kg CO2 per year in regulated carbon dioxide emissions.

The efficiency of each panel has been improved from 20.4% to 22% and an additional 70 No. photovoltaic panels have been included, thereby increasing the peak output from 29kW to 59.3kW since the previous submission to LBTH.

Block I

It is proposed to install photovoltaic panels with a total peak output of 6.5 kW on the roof (based on 17 No., 1.72m², 22% efficient panels). The panels will generate a saving of approximately 537 kg CO2 per year in regulated carbon dioxide emissions.

The efficiency of each panel has been improved from 20.4% to 22% thereby increasing the peak output from 5.8kW to 6.5kW since the previous submission to LBTH.

Block J

It is proposed to install photovoltaic panels with a total peak output of 16 kW on the roofs (based on 42 No., 1.72m², 22% efficient panels). The panels will generate a saving of approximately 1,327 kg CO2 per year in regulated carbon dioxide emissions.

Photovoltaics are therefore proposed for the development.

8.1.3 Solar Thermal

Blocks F, H1/H2, H3 and I

A solar thermal system could provide a proportion of the hot water load but would compete with the site heat network or air-to-water heat pumps serving the base load of the development. Greater carbon reductions are achieved by installing photovoltaics in the limited roof space available.

Solar thermal is therefore not proposed for Blocks F, H and I.

Block J

It is proposed to use solar thermal panels in conjunction with the local heat pumps in each house in Block J as they can generate high temperature heat suitable for domestic hot water, thereby maximising the efficiency of the heat pumps (which are best operating at lower temperature). A collector of 1.1 m² area will be provided on the roof of each dwelling.

The carbon savings generated by the solar thermal panels are reflected in the increased heat pump efficiency and are not reported separately.

Solar thermal is therefore proposed for Block J.

8.1.4 Ground Source Heat Pumps

The overall cooling load is low, resulting in a poor balance between heating and cooling demand, which would adversely impact on the potential yield from any ground source system.

Ground source heat pumps are therefore not proposed for the development.

8.1.5 Air / Water Source Heat Pumps

As described above, heat pumps are proposed for the detailed part of the application as detailed below.

Block I

Air-to-water heat pumps are appropriate as the main heat source for Block I. The heat pumps are expected to provide a total saving of approximately 27,148 kg CO2 per year in regulated carbon dioxide emissions.

Block J

Individual air-to-water heat pumps (supplemented by solar thermal) are appropriate as the main heat source for the houses in Block J.

Individual MVHR heat pumps are appropriate as the main heat source for the maisonettes in Block J.

The heat pumps and solar thermal panels are expected to provide a total saving of approximately 16,044 kg CO2 per year in regulated carbon dioxide emissions.

Air source heat pumps are therefore proposed for the development.

8.1.6 Wind Turbines

Wind turbines would be a complimentary technology to the proposed site heat network. However, they would have significant architectural and townscape implications, together with potential noise.

Wind turbines are therefore not proposed for the development.

8.2 Outline Part of the Application

8.2.1 Biomass Boilers

Biomass boilers are not appropriate for the outline part of the application due to their adverse impact on local air quality.

Biomass boilers are therefore not proposed for the development.

8.2.2 Photovoltaics (PVs)

It is proposed that photovoltaic panels will be installed on the roofs of the residential blocks in the outline part of the application.

Although the exact numbers cannot be determined at this stage, it is expected that a minimum of 420 No. photovoltaic panels will be installed on the roofs, based on a pro-rata increase from Block I. The panels will have a total peak output of 159.6 kW (based on 1.72m², 22% efficient panels). The panels will generate a saving of approximately 13,287 kg CO2 per year in regulated carbon dioxide emissions.

In accordance with GLA Energy Assessment Guidance 2022, PV provision will be maximised when the design for the Reserved Matters application(s) is developed.

Photovoltaics are therefore proposed for the development.

8.2.3 Solar Thermal

Solar thermal systems could provide a proportion of the hot water load, but would compete with the air-to-water heat pumps and potential waste heat source serving the base load of the development. Greater carbon reductions are achieved by installing photovoltaics in the limited roof space available.

Solar thermal is therefore not proposed for most of the development.

8.2.4 Ground Source Heat Pumps

The overall cooling load is low, resulting in a poor balance between heating and cooling demand, which would adversely impact on the potential yield from any ground source system.

Ground source heat pumps are therefore not proposed for the development.

8.2.5 Air / Water Source Heat Pumps

As stated above, air-to-water and water-to-water heat pumps are appropriate as the main heat source for the outline part of the application. The heat pumps are expected to provide a total saving of approximately 649,474 kg CO2 per year in regulated carbon dioxide emissions.

Air source heat pumps are therefore proposed for the development.

8.2.6 Wind Turbines

Wind turbines would be a complimentary technology to the proposed site heat network. However, they would have significant architectural and townscape implications, together with potential noise.

Wind turbines are therefore not proposed for the development.

9 Unregulated Energy

9.1 Detailed Part of the Application

This section outlines how non-regulated energy and carbon dioxide emissions will be reduced through the use of energy efficient appliances and equipment, controls, good management practice, etc.

9.1.1 Baseline

The energy demand and associated carbon dioxide emissions from unregulated uses, i.e. those not covered by the Building Regulations assessments (e.g. cooking and appliances), have been estimated using the UK Government Household Electrical Survey (2014) for the residential elements and using data from CIBSE Guide F for non-residential.

The table below details the breakdown of baseline unregulated energy demand and associated CO_2 emissions for the detailed part of the application.

Energy Use	Residential		Non-Residential	
	Total Energy Demand (kWh/year)	Total Carbon Dioxide Emissions (kg CO_2/year)	Total Energy Demand (kWh/year)	Total Carbon Dioxide Emissions (kg CO_2/year)
Residential cooking (electric)	101,936	13,863		
Residential appliances/equipment	174,621	23,748		
Non-residential cooking (electric)			3,862	525
Non-residential appliances/equipment			69,049	9,390
Total (Unregulated)	276,557	37,612	72,910	9,916

Table 18: Baseline unregulated energy demand and CO2 emissions for detailed part of the application

9.1.2 Demand Reduction (Be Lean)

An assessment has been carried out to determine how unregulated energy and carbon dioxide emissions can be reduced through the use of energy efficient appliances and equipment, controls, good management practice, etc.

The table below details the breakdown of unregulated energy demand and associated CO_2 emissions following demand reduction for the detailed part of the application.

Energy Use	Residential		Non-Residential	
	Total Energy Demand (kWh/year)	Total Carbon Dioxide Emissions (kg CO_2/year)	Total Energy Demand (kWh/year)	Total Carbon Dioxide Emissions (kg CO_2/year)
Residential cooking (electric)	82,262	11,188		
Residential appliances/equipment	142,086	19,324		
Non-residential cooking (electric)			3,439	468
Non-residential appliances/equipment			58,885	8,009
Total (Unregulated)	224,348	30,511	62,323	8,476

Table 19: Unregulated energy demand and CO2 emissions after demand reduction for detailed part of the application

It is expected that the detailed part of the application will provide a 14.5% reduction in unregulated carbon dioxide emissions over the baseline.

It is expected that the energy demand reduction will be achieved by a combination of measures including those detailed below.

9.1.2.1 Residential Cooking

The baseline energy demand and associated carbon dioxide emissions from BREDEM are assumed to be based on the use of appliances with a good standard of energy efficiency commonly available in the commercial market, such as ‘A’ rated electric ovens and ‘D’ rated cooker hood extract units.

More efficient appliances are easily available, and provision of ‘A+’ rated oven and a ‘C’ rated cooker hood extract units will be encouraged.

9.1.2.2 Residential Appliances/Equipment

The baseline energy demand and associated carbon dioxide emissions from BREDEM are assumed to be based on the use of appliances with a good standard of energy efficiency commonly available in the commercial market, such as ‘A+’ rated fridge/freezers, ‘A++’ rated washing machines, ‘A+’ rated dishwashers and ‘A’ rated televisions.

More efficient appliances are easily available, and purchasers/tenants will be encouraged to reduce energy demand by providing an ‘A++’ rated fridge/freezer, an ‘A+++’ rated washing machine, an ‘A++’ rated dishwasher and an ‘A+’ rated television.

Further reductions in unregulated energy can be achieved by owners/tenants of residential properties as detailed below. The potential savings are difficult to quantify as they are operational items. A reduction has not been included in this assessment, but owners/tenants will be encouraged to operate appliances as suggested.

Washing Machine and Dryer

Wash full loads rather than just a few items.

Use a temperature setting of 40°C or even 30°C where possible.

Reduce dryer use by using an outdoor line in summer and a drying rack in winter.

Use tumble dryer balls to reduce drying time.

Dishwasher

Fill the dishwasher before using.

Use the economy setting if available.

Kettle

Only boil the amount you need each time.

Oven

Limit the number of times the oven door is opened while cooking.

Hob

Use the smallest pot possible each time.

Use a lid.

Use stacked steamers.

General Appliances

Do not leave appliances on standby.

9.1.2.3 Non-residential Equipment/Small Power

Tenants will be encouraged to reduce energy demand and associated carbon dioxide emissions to achieve the CIBSE good practice benchmarks.

It is expected that the energy demand reduction will be achieved by a combination of measures including those detailed below.

Retail Space

- Optimisation of refrigeration storage temperatures.
- Specification of refrigeration equipment to include (where possible) automatic defrost, self-closing doors, fan assistance (with auto shut-off and energy efficient fans), high performance insulation, and door open alarms.
- Energy efficient glass and dishwashers to be used.
- Energy efficient desktop PCs, laptops, screens etc to be used.
- Energy efficient sound systems to be used.
- Encourage staff to switch off equipment when not in use.
- Energy efficient TVs, white goods and other equipment to be used.

10 Overheating and Cooling

10.1 Detailed Part of the Application

10.1.1 Cooling Hierarchy

The detailed part of the application has been assessed in accordance with the cooling hierarchy detailed in policy SI 4 of the London Plan, the latest GLA Energy Assessment Guidance 2022 and Building Regulations Part O, in order to reduce overheating and minimise the use of air conditioning.

10.1.1.1 Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure

The heat entering the building will be reduced by a combination of measures including the following: -

- Significantly improved fabric 'U' values
- Improved air tightness
- Optimisation of glazing g-value
- Optimisation of glazing area
- External shading via projecting balconies and deep reveals
- Internal blinds

10.1.1.2 Minimise internal heat generation through energy efficient design

Internal heat generation will be minimised by a combination of measures including the following: -

- Minimising cold bridging
- Minimising heat loss from heating and hot water systems through reducing pipe lengths, pipework arrangements and high levels of insulation
- Low energy lighting
- Energy efficient desktop PCs, laptops, screens
- Energy efficient appliances

10.1.1.3 Manage the heat within the building through exposed internal thermal mass and high ceilings

- Floor to floor heights have been maximised in the proposed development.
- Purge ventilation can be achieved in residential dwellings through open windows
- Building structure is concrete providing thermal mass to absorb excess heat

10.1.1.4 Provide passive ventilation

Passive ventilation will be maximised by a combination of measures including the following: -

- Residential dwellings are designed with shallow floorplates
- Dual aspect dwellings where possible
- All residential dwellings are provided with natural ventilation via openable windows

10.1.1.5 Mechanical ventilation

Mechanical ventilation will assist in mitigating through the following measures;-

- Mechanical ventilation with high efficiency heat recovery (MVHR) will provide fresh air and extract moisture/pollutants in accordance with Building Regulations Part F.
- MVHR will have a bypass for summer mode operation
- MVHR will have a boost mode to increase ventilation rate and assist in reducing the risk of overheating when needed
- Dynamic modelling demonstrates that the risk of overheating is suitably reduced in residential dwellings through the use of natural ventilation via open windows and mechanical ventilation
- Dynamic modelling demonstrates that the risk of overheating cannot be suitably reduced through the use of mechanical ventilation alone, where windows need to remain closed at night due to higher external noise levels. This will be mitigated by temperaing the fresh air supply using the MVHR heat pump or additional cooling module.
- Dynamic modelling demonstrates that the risk of overheating cannot be suitably reduced in the commercial space through the use of natural ventilation via open windows and mechanical ventilation

10.1.1.6 Active Cooling Systems

- The use of active cooling has been minimised through the incorporation of the above passive measures
- It is proposed to provide active cooling to the retail, commercial and marketing spaces only. High efficiency air source heat pumps will be used.
- The module fitted to the MVHR units in the apartments affected by higher external noise levels is not considered as active cooling due to the following;-
  - It would only 'temper' the supply air, reducing the temperature by a few degrees.
  - It would have limited cooling capacity due to the size of heat pump / cooling module, and the low air volume of the residential ventilation system.
  - It would not 'control' space temperature – it would only be used if required by the occupant and would only operate when external temperature exceeds 26 ºC at night and 28ºC during the day to achieve compliance with the CIBSE overheating criteria.
  - No additional fan would be required in the apartment.

10.1.2 Early Stage Overheating Risk Tool

As requested in the Energy Assessment Guidance, the Good Homes Alliance (GHA) Early Stage Overheating Risk Tool has been completed and is provided in Appendix A.7.

10.1.3 Overheating Risk Assessment Methodology

10.1.3.1 Domestic

The residential assessment includes dynamic thermal modelling on a representative sample of dwellings to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM59 guidance.

The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in new developments. TM 59 Design Methodology for the Assessment of Overheating Risk in Homes should be used for residential developments.

For compliance with CIBSE TM 59, the modelled apartments must pass both of the following two criteria:

a) For living rooms, kitchens and bedrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).

b) For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both (a) and (b) above must be passed for all relevant rooms.

Building Regulations Part O requires the modelling to assume that bedroom windows are closed at night if the average 8 hour ambient noise level exceeds 40 dB. The overheating risk categories assessment provided in Annex 14 of the Environment Statement Appendix: Noise and Vibration demonstrates that for most of the detailed part of the application the ambient noise levels are below 40 dB at night (identified as negligible or low risk).

The strategy will therefore generally allow for windows to be open at night in the detailed part of the application .

The overheating risk categories assessment shows that most of Block J, and parts of Blocks F and H1/H2 are subject to ambient noise levels over 40 dB at night (identified as medium or high risk) so two overheating assessments have been completed (one with windows open at night, and one with windows closed at night) to demonstrate that the passive design has been maximised.

10.1.3.2 Non-Domestic

The non-residential assessment includes dynamic thermal modelling of the non-residential space in the detailed part of the application to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM52 guidance.

A room or building that fails any two of the three criteria is classed as overheating.

- The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September).
- The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.
- The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

10.1.3.3 Weather Data

The weather file used for the assessment is as per TM59: DSY1 (Design Summer Year) for the site location, for the 2020s, high emissions, 50% percentile scenario.

The London Heathrow weather data set has been used which is the most representative for the site location.

It is expected that the CIBSE compliance criteria are met for the DSY1 weather scenario.

Additional testing has been undertaken for the residential apartments using the 2020 versions of the following more extreme design weather years;-

- DSY2 – 2003: a year with a very intense single warm spell.
- DSY3 – 1976: a year with a prolonged period of sustained warmth.

It is acknowledged in the GLA Energy Assessment Guidance 2022 that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files, and compliance is therefore not expected.

10.1.4 Summary of Overheating Modelling Results

10.1.4.1 Domestic

Natural Ventilation via Openable Windows (All Blocks)

All residential dwellings tested have been modelled with natural ventilation via openable windows/doors and increased mechanical ventilation to demonstrate that passive measures have been maximised and the façade design has been optimised. The results are summarised below;-

- The CIBSE compliance criteria are met in all rooms modelled (for the 2020s DSY1 weather scenario) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.
- The CIBSE compliance criteria are met in a significant proportion of the rooms modelled (for the 2020s DSY2 and 3 weather scenarios) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.

The GLA Energy Assessment Guidance 2022 expects that the CIBSE compliance criteria is met for the DSY1 weather scenario. It is acknowledged that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files, although it is expected that in the majority of cases a significant proportion of spaces will be able to achieve compliance.

The assessment with natural ventilation demonstrates that the risk of overheating has been reduced as far as practical, with all available passive measures explored.

Closed Windows (Block J, Parts of Blocks F and H1/H2)

The overheating risk categories assessment (see Annex 14 of the Environment Statement Appendix: Noise and Vibration) shows that most of Block J, and parts of Blocks F and H1/H2 are subject to ambient noise levels over 40 dB at night (identified as medium or high risk) and therefore exceed the limit prescribed in Building Regulations Part O.

Additional modelling has been carried out for the appropriate sampled dwellings in Blocks J, F and H1/H2 with the windows closed at night but with the increased mechanical ventilation in operation. The results are summarised below;-

- The CIBSE compliance criteria cannot be met in all rooms modelled (for the 2020s DSY1 weather scenario) without blinds with closed windows/doors and increased mechanical ventilation.
- The CIBSE compliance criteria cannot be met in a significant proportion of the rooms modelled (for the 2020s DSY2 and 3 weather scenarios) without blinds with closed windows/doors and increased mechanical ventilation.

The MVHR heat pumps proposed for the maisonettes in Block J have the capability to lower the temperature of the supply air when in operation to assist in reducing the impact of high summer temperatures.

In the Block J houses and in the affected apartments in Blocks F and H1/H2, an additional cooling module would be fitted to the MVHR unit to provide the same functionality.

This would provide the occupants with an alternative method of sufficiently reducing the risk of overheating without opening the windows.

This is not considered as active cooling due to the following;-

- It would only ‘temper’ the supply air, reducing the temperature by a few degrees.

- It would have limited cooling capacity due to the size of heat pump / cooling module, and the low air volume of the residential ventilation system.
- It would not 'control' space temperature – it would only be used if required by the occupant and would only operate when external temperature exceeds 26 ºC at night and 28ºC during the day to achieve compliance with the CIBSE overheating criteria.
- No additional fan would be required in the apartment.

10.1.4.2 Non-Residential

The non-residential assessment includes dynamic thermal modelling of the non-residential space in the detailed part of the application to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM52 guidance, using the current 2020s summer year (DSY 1) and the more extreme DSY 2 and DSY 3 weather data.

The results of the dynamic modelling overheating assessment are summarised below;-

- The CIBSE compliance criteria cannot be met in the non-residential space (for the 2020s DSY1, 2 and 3 weather scenarios) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation.

The proposed overheating mitigation measures are summarised below;-

- For the retail, commercial, marketing suite and other appropriate areas active cooling is proposed.

10.1.5 Overheating Mitigation Measures

The proposed overheating mitigation measures are summarised below;-

- In residential dwellings the use of natural ventilation via openable windows/doors and increased mechanical ventilation will generally sufficiently reduce the risk of overheating.
- In Block J and parts of Blocks F and H1/H2, where the occupants may choose to keep their windows closed at night, an alternative method of reducing the risk of overheating will be available through the use of the MVHR heat pump or a MVHR cooling module.
- During extreme summer weather, residents will be encouraged to use additional measures to reduce the risk of overheating, including the following;-
  - Using portable fans to increase airflow
  - Minimising internal heat gains
  - Keeping windows open as long as possible
- Guidance will be provided to residents on reducing the overheating risk in their home in line with the cooling hierarchy.

10.2 Outline Part of the Application

Residential

Although dynamic thermal modelling is not a requirement for the outline part of the application, as part of the early stage design modelling has been carried out on a sample of apartments to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM59 guidance, using the current 2020s summer year (DSY 1) and the more extreme DSY 2 and DSY 3.

This modelling has been completed for a sample of west facing apartments at differing levels between the 2nd and 20th floor with both recessed and projecting balconies.

The results of this early stage dynamic modelling overheating assessment are summarised below;-

- The CIBSE compliance criteria are met in almost all rooms modelled (for the 2020s DSY1 weather scenario) for both recessed and projecting balconies, without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.
- The CIBSE compliance criteria are met in a significant proportion of the rooms modelled (for the 2020s DSY2 and 3 weather scenarios) without blinds through the use of natural ventilation via openable windows/doors and increased mechanical ventilation, together with an improvement of the glazing g-value to 0.33.

The results demonstrate that the outline design provides a suitable reduction in the risk of overheating at this stage of design.

As the design is developed for the later Reserved Matters application(s), further work will be done to explore all available passive measures with the aim of reducing the risk further.

Non-Residential

The design of the outline part of the application is not sufficiently progressed to allow dynamic thermal modelling for the non-residential areas.

As the design is developed for the later Reserved Matters application(s), an assessment will be carried out to reduce overheating and minimise the use of air conditioning in the non-residential areas.

Appendix A.1 – SAP Calculations (Be Lean)

Appendix A.2 - SAP Calculations (Be Green)

Appendix A.3 – BRUKL Reports (Be Lean)

Appendix A.4 - BRUKL Reports (Be Green)

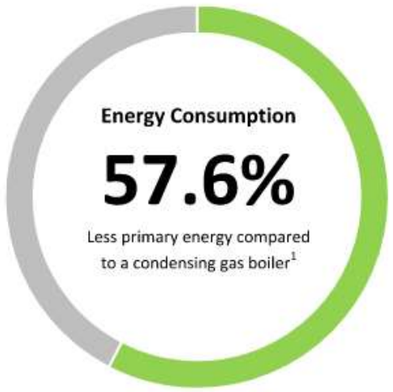
Appendix A.5 – Block I Heat Pump Selection

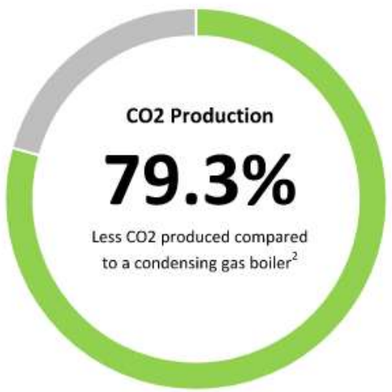
Commercial Heating

Heat Pump Selection

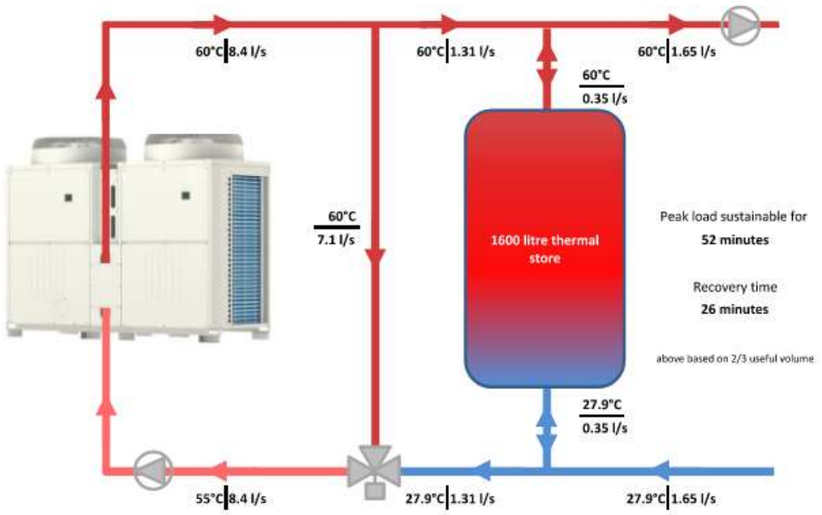
Version 2.10

Project	**Aberfeldy Block I**
PRO Number	**PRO-33606**
Prepared by	**Ryan Grant**





Selected Unit(s)	**4 x CAHV-P500YB-HPB**		
Heat Pump Capacity	**164 kW**	**Air -5°C/Water 60°C**	**(EN 14511)**
ΔT	**5**		
SCOP	**3.1** [1]	**- 60°C**	**(EN 14825)**



1) Gas boiler based on 99% efficiency and the heat pump SCOP based on tested value, not project specific value
2) Natural gas carbon factor based on 0.21 kgCO2/kWh and electricity carbon factor based on 0.136 kgCO2/kWh

Mitsubishi Electric takes no design responsibility or liability for the system, components, equipment selections or control strategy – it is your responsibility to check the suitability of the proposed equipment selections

Calculation Reference Points

Primary (Central Plant)	HTG	HWS
Flow (°C)	60	60
Ret (°C)	37	20
ΔT	23	40

Secondary (Distribution)	HTG	HWS
Flow (°C)	60	60
Ret (°C)	37	20
ΔT	23	40

Same as primary unless separated by PHEX

Tertiary (Apartment)	HTG	HWS
Flow (°C)	55	50
Ret (°C)	35	10
ΔT	20	40

Schedule of Accommodation

Type	No.	no. bathrooms	Heat Loss (kW)	Summated flow to all outlets, ∑qf	DHW Load (kW)	∑qfpeak (l/s)
1B2P	22	1	1.79	0.24	40	5.34
2B3P	2	2	2.73	0.34	56	0.68
2B4P	24	2	2.73	0.34	56	8.16
2B4P	2	3	2.73	0.44	72	0.88
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
Total	50					15.05

These values can be used to calculate flow rates for network pipes. However these values are not necessarily suitable for the sizing of HIUs. See section 5.4.5 of CIBSE Design Guide, Heat Networks, Sept 2021

Commercial/Communal

Area (m2)	W/m2	Heat Loss (kW)
-	-	-

Hot Water (kW)	-

DHW flow rates are either given by the customer or derived from Summated Flow Rates in Table 5, Section 4.4.2, CIBSE Design Guide, Heat Networks, Sept 2021

DHW

Undiversified DHW	2490 kW	
DHW Diversity Factor	0.0588	based on: qd = 2qm + θ(∑qf-2qm) + AV(qm.θ).√(∑qf-2qm) = 0.885
Diversified DHW:	**147 kW**	where: ∑qf = 15.05 , qm = 0.1, A = 3.1, θ = 0.015 diversity factor = qd/$\sum q_{tpeak}$ DS439 (Dansk Standard, 2009)

Heating

Undiversified Heating	116 kW	
Heating Diversity Factor	0.6276	based on: 0.62 + 0.38 / number of dwellings [Varme Ståbi (Heat Stability) (Lauritsen, 2015)], or given by the customer
Diversified Heating:	**73 kW**	

Estimated total diversified peak demand: 220 kW [3]

Thermal Store

Instantaneous hot water loads typically experience peaks during busy periods, such as early morning or evening, when multiple occupants are taking showers and baths that coincide. However, these peaks may only last for short periods (maybe minutes or even seconds), with loads dropping to much lower levels once the peak is over. Hence, it is not usually appropriate to size central heat sources to cope with these high but short-lived demands. A central thermal store can be used to cope with the peaks, while heat sources are sized such that they refill the store within a reasonable time period. (CIBSE Design Guide, Heat Networks, Sept 2021, Section 3.4.4)

Thermal Store volume: **1594 litres** based on: Vp = tp x qmts x 3/2

Where Vp is the volume required to cope with 20 minutes peak hot water load (litres), tp is the estimated period at peak load (s), qmts is the maximum possible flow from the thermal store to the network (l/s), assuming 2/3 useful volume in the thermal store.

Heat Source sizing

The installed peak output capacity of heat sources can usually be lower than the peak heat demand for the network, the difference being made up by the heat output available from the thermal store. The central heat sources should be sized to provide sufficient capacity to reheat the store within a reasonable time (i.e. before the next peak load condition occurs). Although it depends on the circumstances, it would be unusual to assume more than 1 hour between each peak load occurrence. (CIBSE Design Guide, Heat Networks, Sept 2021, Section 3.6)

Heat Source required: **133 kW** based on: Peak heating demand + 60 minutes recovery of thermal store

3) Full calculations can be provided upon request

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Appendix A.6 – Heating Load Profile Assessment

Energy Summary

Heating Energy	Residential	3,205,411	kWh
	Commercial	462,824	kWh
Cooling Energy	Residential	190,920	kWh
DHW Energy	Residential	2,563,721	kWh

Total Heating Energy	3,668,234	kWh
Total DHW Energy	2,563,721	kWh
Total Heating & DHW Energy	6,231,955	kWh
Total Cooling Energy	190,920	kWh

Water Source Heat Pump (WSHP)		
WSHP Delivered Heating Energy	6,231,955	kWh
WSHP Consumed Energy	1,546,391	kWh
WSHP SCOP	4.03	
WSHP Heat Absorbed from Loop	4,685,565	kWh

Model	EW-HT /0612	
Condenser temps inlet/outlet	50/60	°C
Evaporator temps inlet/outlet	25/18	°C
WSHP Capacity	176.4	kW
Total no.	32	
Total output capacity	5644.8	kW

*selected at N+1

	4 x EW-HT 0612	5 x EW-HT 0612	5 x EW-HT 0612	8 x EW-HT 0612	5 x EW-HT 0612	5 x EW-HT 0612
	PHASE 4B HP A1/A2	PHASE 4B HP B1/B2	PHASE 4B HP B3	PHASE 4C HP Block C	PHASE 4D HP Block E	PHASE 4D HP D1/D2
	WSHP SEC. STAGE (60/50 COND.) 25/18 EVAP.	WSHP SEC. STAGE (60/50 COND.) 25/18 EVAP.	WSHP SEC. STAGE (60/50 COND.) 25/18 EVAP.	WSHP SEC. STAGE (60/50 COND.) 25/18 EVAP.	WSHP SEC. STAGE (60/50 COND.) 25/18 EVAP.	WSHP SEC. STAGE (60/50 COND.) 25/18 EVAP.
Output per unit	176.4 kW	176.4 kW	176.4 kW	176.4 kW	176.4 kW	176.4 kW
Total output	705.6 kW	882 kW	882 kW	1411.2 kW	882 kW	882 kW
Load to serve	427 kW	629 kW	637 kW	1145 kW	567 kW	567 kW
Thermal Store volume	3000 litres	5000 litres	4000 litres	9000 litres	4000 litres	4000 litres

Water Cooled Chiller (WCC)		
WCC Delivered Cooling Energy	190,920	kWh
WCC Consumed Energy	29,453	kWh
WCC SEER	6.48	
WCC Heat Rejected to Loop	220,374	kWh

Model	NX-W /0122-0302	
Condenser temps inlet/outlet	25/31	°C
Evaporator temps inlet/outlet	18/12	°C
WCC Capacity	46.4 to 117.6	kW
Total no.	12	
Total output capacity	1035	kW

*selected at 2 at ~66%

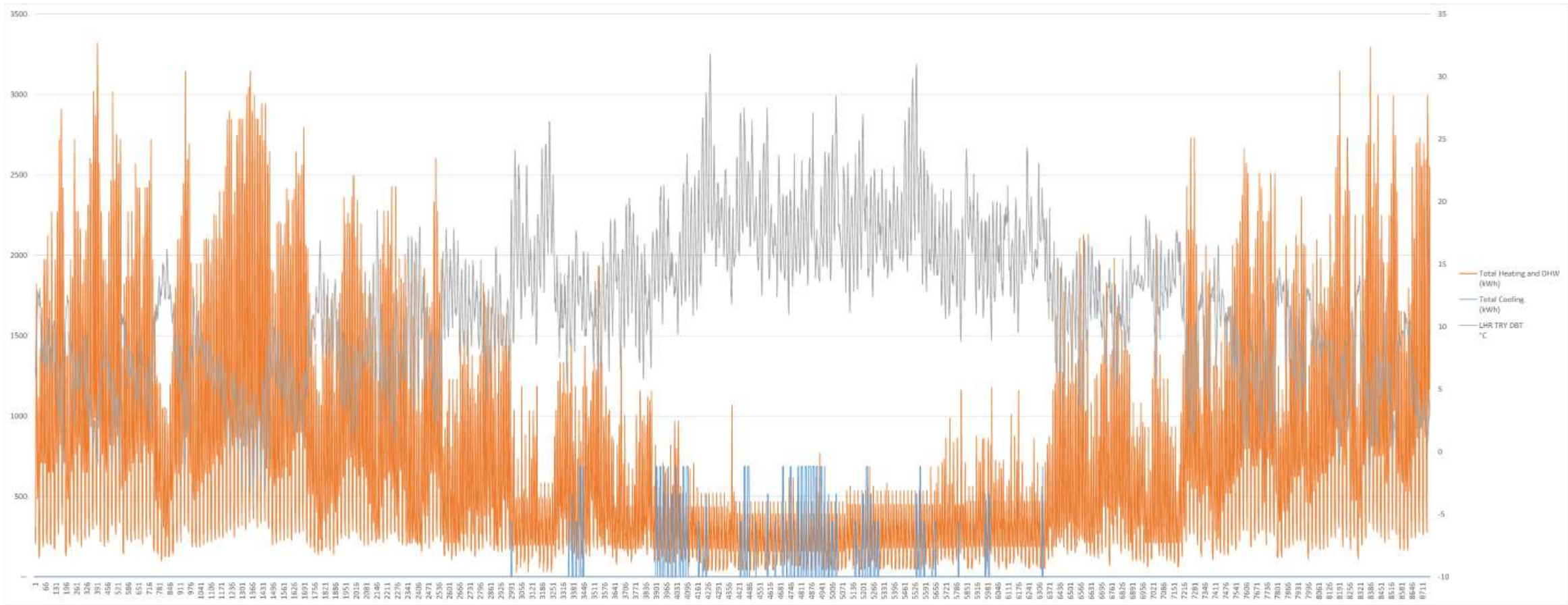
	2 x NX-W 0182	2 x NX-W 0302	2 x NX-W 0252	2 NX-W 0302	2 x NX-W 0202	2 x NX-W 0122
	PHASE 4B HP A1/A2	PHASE 4B HP B1/B2	PHASE 4B HP B3	PHASE 4B HP Block C	PHASE 4B HP Block E	PHASE 4B HP D1/D2
	WCC SEC. STAGE (12/18 EVAP.) 25/31 COND.	WCC SEC. STAGE (12/18 EVAP.) 25/31 COND.	WCC SEC. STAGE (12/18 EVAP.) 25/31 COND.	WCC SEC. STAGE (12/18 EVAP.) 25/31 COND.	WCC SEC. STAGE (12/18 EVAP.) 25/31 COND.	WCC SEC. STAGE (12/18 EVAP.) 25/31 COND.
Output per unit	68.3 kW	117.6 kW	88.3 kW	117.6 kW	79.3 kW	46.4 kW
Total output	136.6 kW	235.2 kW	176.6 kW	235.2 kW	158.6 kW	92.8 kW
Load to serve	102.7 kW	164.1 kW	134.0 kW	173.1 kW	107.2 kW	4.5 kW
						*low load, suggest alternative system

Heat Recovered in Loop due to simultaneous loads	78,171	kWh
Heat Recovered in primary thermal store due to deadband contro	TO DC	kWh

ASHP		
ASHP Delivered Heating Energy	4,607,394	kWh
ASHP Delivered Cooling Energy	142,203	kWh
ASHP Consumed Energy for Heating	881,291	kWh
ASHP Consumed Energy for Cooling	30,430	kWh
ASHP SCOP	5.23	
ASHP SEER	4.67	

Model	NX2-N-G06 /A /0808		
Condenser temps inlet/outlet	19/25	°C	
Evaporator temps inlet/outlet	21/15	°C	
Heating Capacity @ -5°C	599.5	kW	
no. of in heating mode	6		N+1
ASHP Total Heating Capacity	3597	kW	
Cooling Capacity @+36°C	971.9	kW	
no. of in cooling mode	2		N+1
ASHP Total Cooling Capacity	1943.8	kW	
Total no units	6		

Combined Plant Efficiency		
Total Cooling SEER	3.19	
Total Heating SCOP	2.57	


3500
3000
2500
2000
1500
1000
500
-
35
30
25
20
15
10
5
0
-5
-10
Total Heating and DHW (kWh)
Total Cooling (kWh)
LHR TRY DBT °C

Appendix A.7 – Early Stage Overheating Risk Tool

EARLY STAGE OVERHEATING RISK TOOL

Version 1.0, July 2019

This tool provides guidance on how to assess overheating risk in residential schemes at the early stages of design. It is specifically a pre-detail design assessment intended to help identify factors that could contribute to or mitigate the likelihood of overheating.

The questions can be answered for an overall scheme or for individual units. Score zero wherever the question does not apply. Additional information is provided in the accompanying guidance, with examples of scoring and advice on next steps.

Find out more information and download accompanying guidance at goodhomes.org.uk/overheating-in-new-homes

Good Homes Alliance

KEY FACTORS INCREASING THE LIKELIHOOD OF OVERHEATING | **KEY FACTORS REDUCING THE LIKELIHOOD OF OVERHEATING**

Geographical and local context

#1 Where is the scheme in the UK? See guidance for map	South east	4	4
	Northern England, Scotland & NI	0	
	Rest of England and Wales	2	
#2 Is the site likely to see an Urban Heat Island effect? See guidance for details	Central London (see guidance)	3	3
	Grtr London, Manchester, B'ham	2	
	Other cities, towns & dense sub-urban areas	1	

#8 Do the site surroundings feature significant blue/green infrastructure? Proximity to green spaces and large water bodies has beneficial effects on local temperatures; as guidance, this would require at least 50% of surroundings within a 100m radius to be blue/green, or a rural context	1	0

Site characteristics

#3 Does the site have barriers to windows opening? - Noise/Acoustic risks - Poor air quality/smells e.g. near factory or car park or very busy road - Security risks/crime - Adjacent to heat rejection plant	**Day** - reasons to keep all windows closed	8	4
	Day - barriers some of the time, or for some windows e.g. on quiet side	4	
	Night - reasons to keep all windows closed	8	4
	Night - bedroom windows OK to open, but other windows are likely to stay closed	4	

#9 Are immediate surrounding surfaces in majority pale in colour, or blue/green? Lighter surfaces reflect more heat and absorb less so their temperatures remain lower; consider horizontal and vertical surfaces within 10m of the scheme	1	0
#10 Does the site have existing tall trees or buildings that will shade solar-exposed glazed areas? Shading onto east, south and west facing areas can reduce solar gains, but may also reduce daylight levels	1	0

Scheme characteristics and dwelling design

#4 Are the dwellings flats? Flats often combine a number of factors contributing to overheating risk e.g. dwelling size, heat gains from surrounding areas; other dense and enclosed dwellings may be similarly affected - see guidance for examples	3	3
#5 Does the scheme have community heating? i.e. with hot pipework operating during summer, especially in internal areas, leading to heat gains and higher temperatures	3	3

#11 Do dwellings have high exposed thermal mass AND a means for secure and quiet night ventilation? Thermal mass can help slow down temperature rises, but it can also cause properties to be slower to cool, so needs to be used with care - see guidance		1	0
#12 Do floor-to-ceiling heights allow ceiling fans, now or in the future? Higher ceilings increase stratification and air movement, and offer the potential for ceiling fans	>2.8m and fan installed	2	0
	> 2.8m	1	

Solar heat gains and ventilation

#6 What is the estimated average glazing ratio for the dwellings? (as a proportion of the facade on solar-exposed areas i.e. orientations facing east, south, west, and anything in between). Higher proportions of glazing allow higher heat gains into the space	>65%	12	4
	>50%	7	
	>35%	4	
#7 Are the dwellings single aspect? Single aspect dwellings have all openings on the same facade. This reduces the potential for ventilation	Single-aspect	3	3
	Dual aspect	0	

#13 Is there useful external shading? Shading should apply to solar exposed (E/S/W) glazing. It may include shading devices, balconies above, facade articulation etc. See guidance on "full" and "part". Scoring depends on glazing proportions as per **#6**		Full	Part	1
	>65%	6	3	
	>50%	4	2	
	>35%	2	1	

#14 Do windows & openings support effective ventilation? Larger, effective and secure openings will help dissipate heat - see guidance		Openings compared to Part F purge rates			3
		= Part F	+50%	+100%	
	Single-aspect	minimum required	3	4	
	Dual aspect		2	3	

TOTAL SCORE	24	= Sum of contributing factors:	28	*minus*	Sum of mitigating factors:	4

High 12 **Medium** 8 **Low**

score >12:
Incorporate design changes to reduce risk factors and increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score between 8 and 12:
Seek design changes to reduce risk factors and/or increase mitigation factors
AND Carry out a detailed assessment (e.g. dynamic modelling against CIBSE TM59)

score <8:
Ensure the mitigating measures are retained, and that risk factors do not increase (e.g. in planning conditions)

Appendix A.8 - Overheating Assessment

A.8 Overheating Assessment

As requested in the Energy Assessment Guidance, the Good Homes Alliance (GHA) Early Stage Overheating Risk Tool has been completed and is provided in Appendix A.7.

Detailed Part of the Application

The detailed part of the application has been assessed in accordance with the cooling hierarchy detailed in policy SI 4 of the London Plan, the latest GLA Energy Assessment Guidance 2022 and Building Regulations Part O, in order to reduce overheating and minimise the use of air conditioning.

The assessment includes dynamic thermal modelling of both the domestic and non-domestic elements of the proposed development to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49, TM52 and TM59.

Outline Part of the Application

An initial early stage assessment has also been carried out for the outline part of the application.

Although dynamic thermal modelling is not a requirement for the outline part of the application, as part of the early stage design modelling has been carried out on a sample of residential apartments to assess the risk of overheating, using IES modelling software, in accordance with the guidance and data sets in CIBSE TM49 and TM59 guidance, using the current 2020s summer year (DSY 1) and the more extreme DSY 2 and DSY 3.

This modelling has been completed for apartments with both recessed and projecting balconies.

A.8.1 Overheating Risk Assessment Methodology

Domestic (Apartments)

The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in new developments. TM 59 Design Methodology for the Assessment of Overheating Risk in Homes should be used for residential developments.

For compliance with CIBSE TM 59, the modelled apartments must pass both of the following two criteria:

a) For living rooms, kitchens and bedrooms: the number of hours during which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).

b) For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26°C will be recorded as a fail).

Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both (a) and (b) above must be passed for all relevant rooms.

Building Regulations Part O requires the modelling to assume that bedroom windows are closed at night if the average 8 hour ambient noise level exceeds 40 dB.

Non-Domestic

The non-domestic overheating risk assessment has been made against the three criteria outlined in CIBSE TM52. A room or building that fails any two of the three criteria is classed as overheating.

- The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September).
- The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.
- The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

Weather Data

The weather file used for the assessment is as per TM59: DSY1 (Design Summer Year) for the site location, for the 2020s, high emissions, 50% percentile scenario.

The London Heathrow weather data set has been used which is the most representative for the site location.

It is expected that the CIBSE compliance criteria are met for the DSY1 weather scenario.

Additional testing has been undertaken for the residential apartments using the 2020 versions of the following more extreme design weather years;-

- DSY2 – 2003: a year with a very intense single warm spell.
- DSY3 – 1976: a year with a prolonged period of sustained warmth.

It is acknowledged in the GLA Energy Assessment Guidance 2022 that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files, and compliance is therefore not expected.

A.8.2 Domestic Model Input Data

This section summarises the input assumptions that have been used in the dynamic thermal modelling. The modelling has been carried out in accordance with CIBSE TM59: Design methodology for the assessment of overheating risk in home.

Fabric Performance

Refer to Section 6.

Solar Gain

For the residential apartments the size and g-value of the glazing has been optimised using the dynamic thermal modelling, in order to provide a balance between minimising summer heat gain to prevent overheating, maximising winter heat gain to reduce heating loads, and maximising natural daylight to reduce lighting energy. This has resulted in the g-value of the residential glazing being set at 0.33.

Blinds and Shading Devices

Internal blinds have not been included in the dwellings.

The balconies have been modelled to provide external shading for the apartments.

Mechanical Ventilation

Individual Mechanical Ventilation with Heat Recovery (MHVR) units are proposed to provide fresh air and extract ventilation for the residential dwellings.

These units will be equipped with a summer bypass mode and a boost mode that will enable the unit to achieve an increased total flow rate of up to 75l/s in the summer condition, exceeding the minimum ventilation requirement of Part F of the Building Regulations.

Natural Ventilation

A typical apartment has balcony doors which can be fully opened and side hung opening windows elsewhere to allow natural ventilation when required.

Window opening methodology is in accordance with Building Regulations Part O.

The overheating risk categories assessment provided in Annex 14 of the Environment Statement Appendix: Noise and Vibration demonstrates that for most of the detailed part of the application the ambient noise levels are below 40 dB at night (identified as negligible or low risk).

The strategy will therefore generally allow for windows to be open at night in the detailed part of the application .

The overheating risk categories assessment shows that most of Block J, and parts of Blocks F and H1/H2 are subject to ambient noise levels over 40 dB at night (identified as medium or high risk) so two overheating assessments have been completed (one with windows open at night, and one with windows closed at night) to demonstrate that the passive design has been maximised.

Infiltration

The target air permeability for the development is 3m^3/hr.m^2@50Pa. An average infiltration air change of 0.25ACH has been assumed in the dynamic thermal modelling in accordance with Table 4.24 in CIBSE Guide A.

Air Speed Assumptions

Operative air speed in the apartments has been set at 0.1m/s and assumed elevated air speed of 0.8m/s used in the thermal modelling calculation in accordance with CIBSE TM59.

Thermal Comfort Category

This is a new build development, therefore Cat II building was selected as Normal Expectations.

Internal Gains

A thermal template has been created for each of the spaces within the sample apartments taking into account the internal gains. The internal heat gains consist of occupancy gains, equipment gains and lighting gains. CIBSE TM59 has been used in developing the internal gains profile.

Occupancy Gains

Occupancy heat gains and profiles were assumed in accordance with Table 2 in CIBSE TM59.

Occupancy gain has been set at 75 W/person sensible, 55 W/person latent.

Room Type	Profile/ Gain
Single Bedroom	1 person at 70% gains from 11pm -8am 1 person at full gains from 8am to 11pm
Double Bedroom	2 person at 70% gains from 11pm -8am 2 person at full gains from 8am to 9am and from 10pm to 11pm 1 person at full gains in the bedroom from 9am to 10pm
1 Bedroom (Living room/ kitchen)	1 person from 9am -10am, room is unoccupied for the rest the day
2 Bedroom (Living room/ kitchen)	2 person from 9am -10am, room is unoccupied for the rest the day
3 Bedroom (Living room/ kitchen)	3 person from 9am -10am, room is unoccupied for the rest the day

Table 20: Occupancy Gains

Equipment Gains

Equipment heat gains and profiles were assumed in accordance with Table 2 in CISBE TM59.

Room Type	Profile/ Gain
Living Room/ Kitchen	Peak load of 450W from 6pm-8pm 200W from 8pm- 10pm 110W from 9am to 6pm and from 10pm to 12pm Base load of 85W for the rest of the day
Single Bedroom	Peak load of 80W from 8am to 11pm Base load of 10W during the sleeping hours
Double Bedroom	Peak load of 80W from 8am to 11pm Base load of 10W during the sleeping hours

Table 21: Equipment Gains

Lighting Gains

Lighting gains of 2 W/m^2 have been assumed for each flat for the period of 6pm –11pm in accordance with CIBSE TM59. Lighting Gains of 8W/m2 have been assumed for the communal corridors.

A.8.3 Detailed Part of the Application Overheating Modelling Results

Domestic Dwellings

The results of the dynamic modelling overheating assessment are provided in Appendix A.8, and summarised below;-

Block	Windows	DSY1	DSY2 & 3
Block F	Open	100%	30%
Block H	Open	100%	47%
Block I	Open	100%	52%
Block J	Open	100%	48%
Block F	Closed (at night)	84%	38%
Block H	Closed (at night)	56%	19%
Block J	Closed (at night)	50%	19%

Table 22: TM59 Overheating Assessment results (Part O Compliant)

The results of the assessment of criteria (a) and (b) for the sample residential dwellings in the detailed part of the application are shown below.

2020	DSY1		DSY2		DSY3	
Block F windows openable at night	Criteria a	Criteria b	Criteria a	Criteria b	Criteria a	Criteria b
Room Name	= < 3.0	< 33	= < 3.0	< 33	= < 3.0	< 33
Dbl Bedroom L01.10	1.1	15	3.1	50	2.9	35
Dbl Bedroom L01.10	1.1	15	3.1	50	2.9	35
Dbl Bedroom L01.11	0.5	17	2.2	64	1.7	46
LDK L01.11	0.8	N/A	3.7	N/A	3	N/A
Dbl Bedroom L01.09	1.3	19	3.1	58	3.2	46
Dbl Bedroom L01.09	1.5	20	3.2	60	3.2	48
Dbl Bedroom L01.08	0.5	15	2	56	1.8	42
LDK L01.008	1.1	N/A	3.9	N/A	3.4	N/A
LDK L01.01	0.8	N/A	3.8	N/A	3.1	N/A
Dbl Bedroom L01.01	0.4	17	2	65	1.7	44
Dbl Bedroom L01.02	0.6	19	2.7	66	2.2	47
LDK L01.02	1	N/A	4	N/A	3.4	N/A
Dbl Bedroom L01.03	1.3	18	3.3	49	2.6	39
LDK L01.03	1.8	N/A	4.8	N/A	4.7	N/A
Dbl Bedroom L01.03	0.9	18	3	49	2.6	39
Dbl Bedroom L01.04	0.8	18	2.6	56	2.3	39
Dbl Bedroom L01.04	1	18	2.9	55	2.8	42
LDK L01.04	1.4	N/A	4.6	N/A	4.1	N/A
Dbl Bedroom L01.05	0.8	19	2.7	52	2.6	42
LDK L01.05	1.6	N/A	4.5	N/A	4.3	N/A
Dbl Bedroom L01.07	1.1	15	2.6	46	2.7	33
LDK L01.07	1.3	N/A	4.2	N/A	3.9	N/A
LDK L01.12	0.5	N/A	2.5	N/A	1.7	N/A
Dbl Bedroom L01.06	0.5	17	2.2	67	2	47
LDK L01.06	0.9	N/A	3.7	N/A	3.1	N/A
LDK L01.09	2.4	N/A	5.2	N/A	5.4	N/A
LDK L01.10	1.9	N/A	5.3	N/A	4.9	N/A
LDK L08.01	1.3	N/A	4.9	N/A	4.3	N/A
Dbl Bedroom L08.01	0.6	17	2.7	68	2.1	48
Dbl Bedroom L08.02	0.9	21	3.1	69	2.7	52
LDK L08.02	1.6	N/A	5	N/A	4.4	N/A
Dbl Bedroom L08.03	1.4	18	3.2	53	3.1	42
LDK L08.03	1.8	N/A	5	N/A	4.7	N/A
Dbl Bedroom L08.03	1.3	18	3.1	53	3.1	42
Dbl Bedroom L08.04	1	18	2.8	53	2.6	41
Dbl Bedroom L08.04	1.2	N/A	2.9	N/A	2.9	N/A
LDK L08.04	1.7	N/A	4.6	N/A	4.4	N/A
Dbl Bedroom L08.05	1	19	2.8	50	2.8	44
LDK L08.05	1.7	N/A	4.8	N/A	4.5	N/A
Single Bedroom L08.06	1.1	15	2.8	48	2.8	41
Dbl Bedroom L08.06	1.2	15	2.9	45	3	38
Single Bedroom L08.06	1.3	15	3.1	48	2.8	41
LDK L08.06	2.4	N/A	5.6	N/A	5.7	N/A

2020	DSY1		DSY2		DSY3	
Block F rooms with windows closed at night	Criteria a	Criteria b	Criteria a	Criteria b	Criteria a	Criteria b
Room Name	= < 3.0	< 33	= < 3.0	< 33	= < 3.0	< 33
Dbl Bedroom L01.10	1.1	20	1.9	43	3	55
Dbl Bedroom L01.10	1.1	20	1.9	43	3	55
Dbl Bedroom L01.09	0.5	35	2.1	69	3.3	98
Dbl Bedroom L01.09	0.8	35	2	68	3.3	99
Dbl Bedroom L01.08	1.3	23	1.3	59	1.9	78
LDK L01.008	1.5	N/A	2.8	N/A	4.3	N/A
LDK L01.01	0.5	N/A	2.6	N/A	3.4	N/A
Dbl Bedroom L01.01	1.1	23	1.4	59	1.7	77
Dbl Bedroom L01.02	0.8	25	1.5	63	2.1	84
LDK L01.02	0.4	N/A	2.6	N/A	3.5	N/A
Dbl Bedroom L01.03	0.6	28	2	62	2.8	79
Dbl Bedroom L01.03	1	28	1.8	62	2.8	79
LDK L01.07	1.3	N/A	2.8	N/A	4.3	N/A
LDK L01.09	1.8	N/A	3.9	N/A	6	N/A
LDK L01.10	0.9	N/A	3.7	N/A	5.3	N/A
LDK L08.01	0.8	N/A	3	N/A	5.1	N/A
Dbl Bedroom L08.01	1	36	1.5	74	2.3	107
Dbl Bedroom L08.02	1.4	42	1.8	81	3	115
LDK L08.02	0.8	N/A	3.1	N/A	5.1	N/A
Dbl Bedroom L08.03	1.6	39	2.1	75	3.4	107
Dbl Bedroom L08.03	1.1	39	2.2	75	3.4	107
Single Bedroom L08.06	1.3	26	2	58	3.1	87
LDK L08.06	0.5	N/A	3.8	N/A	6.1	N/A

2020	DSY1		DSY2		DSY3	
Block H windows openable at night	Criteria a	Criteria b	Criteria a	Criteria b	Criteria a	Criteria b
Room Name	= < 3.0	< 33	= < 3.0	< 33	= < 3.0	< 33
BH2 L02.05 Living room	2	N/A	3.3	N/A	2.7	N/A
BH2 L02.05 Kitchen	1.7	N/A	3.3	N/A	2.8	N/A
BH2 L02.04 Living room	1.9	N/A	3.2	N/A	2.5	N/A
BH2 L02.04 Kitchen	1.7	N/A	3.2	N/A	2.9	N/A
BH2 L02.03 LivingRm	0.9	N/A	2.3	N/A	2.7	N/A
BH2 L02.01 Dbl Bedroom	1.4	21	2	35	2.9	52
BH2 L02.01 DBl Bedroom	1.7	21	2	35	2.7	52
BH2 L02.02 Kitchen	2.4	N/A	3.7	N/A	2.5	N/A
BH2 L02.02 LivingRM	1.4	N/A	2.9	N/A	2.5	N/A
BH2 L02.02 F2 DBLBD2	0.8	N/A	1.8	N/A	1.8	N/A
BH2 L02.02 F2 SNGLBD	0.9	N/A	1.8	N/A	1.8	N/A
BH2 L02.02 DBLBD1	0.8	N/A	1.7	N/A	2.4	N/A
BH2 L02.03 Kitchen	0.9	N/A	2.6	N/A	2.5	N/A
BH2 L01.01 DBLBED2	1.4	24	2.1	36	2.7	56
BH2 L01.01 DBLBED1	1.6	24	2.2	38	2.6	56
BH2 L01.02 Kitchen diner	2.6	N/A	3.9	N/A	2.5	N/A

BH2 L01.02 Living room	1.7	N/A	3.2	N/A	2.5	N/A
BH2 L01.02 Dbl Bedroom	0.9	24	1.8	36	2.8	54
BH2 L01.01 Single Bed	1.2	23	1.9	30	2.5	50
BH2 L01.02 Dbl Bedroom	0.8	24	1.8	36	2.5	54
BH2 L03.01 Dbl Bedroom	1.3	24	2	36	2.4	57
BH2 L03.01 Dbl Bedroom	1.5	24	2	36	1.7	57
BH2 L03.01 Living/Dining	2	N/A	3.4	N/A	1.7	N/A
BH2 L03.02 Kitchen	2.6	N/A	3.9	N/A	2.4	N/A
BH2 L03.02 Kitchen	1.7	N/A	3.9	N/A	2.5	N/A
BH2 L03.02 Dbl Bedroom	1	24	1.9	36	2.8	55
BH2 L03.02 Single Bedroom	1.3	23	1.9	30	2.6	50
BH2 L03.02 Dbl Bedroom	0.8	24	1.9	36	2.6	55
BH2 L02.06 Kitchen	2.2	N/A	3.4	N/A	2.6	N/A
BH2 L02.06 Living room	2.6	N/A	3.9	N/A	2.6	N/A
BH2 L01.03 Twin Single Bed	0.9	15	1.6	25	5	41
BH2 L01.03 Dbl Bedroom	1.1	16	1.8	28	4.7	38
BH2 L01.03 Single Bedroom	1.1	20	1.9	31	4.9	48
BH2 L01.03 Dbl Bedroom	0.7	16	1.8	28	4.6	38
BH2 L01.04 Dbl Bedrrom	1.4	17	2.1	30	3.3	44
BH2 L01.04 Dbl Bedroom	1.4	20	2.1	32	3.2	48
BH2 L01.04 Single Bedroom	1.3	18	1.9	24	3.3	41
BH2 L01.04 Dbl Bedroom	1.1	20	2.1	32	5.4	48
BH2 L01.05 Dbl Bedroom	1.4	17	2.1	30	4.3	45
BH2 L01.05 Single Bedroom	1.3	17	2	26	3.3	39
BH2 L01.05 Single Bedroom	1.3	17	2	26	3.2	39
BH2 L01.05 Dbl Bedroom	1.2	17	2.1	30	3.4	45
BH2 L01.06 Twin Single Bedroom	0.5	23	1.3	33	5.7	48
BH2 L01.06 Twin Single Bedroom	0.5	23	1.3	33	4.7	48
BH2 L01.06 Dbl Bedroom	0.8	24	1.7	41	3	62
BH2 L01.06 Single Bedroom	0.6	39	1.7	56	3.1	75
BH2 L01.01 Living/Kitchen	2.3	N/A	3.5	N/A	3.3	N/A
BH1 L01.01 DBLBED2	1.3	25	2.2	35	4.9	58
BH1 L01.01 DBLBED1	1.5	25	2.3	35	5.8	58
BH1 L01.02 Living room	1.7	N/A	3.1	N/A	4.8	N/A
BH1 L01.02 Dbl Bedroom	1	24	1.8	36	3.2	53
BH1 L01.01 Single Bed	1.1	22	1.9	34	5.2	48
BH1 L01.02 Dbl Bedroom	0.8	24	1.8	36	5.6	53
BH1 L01.03 Twin Single Bed	0.9	15	1.6	24	2.8	41
BH1 L01.03 Dbl Bedroom	1	16	1.7	28	2.9	38
BH1 L01.03 Single Bedroom	1.1	20	1.9	32	3.2	48
BH1 L01.03 Dbl Bedroom	0.7	16	1.7	28	3.2	38
BH1 L01.04 Dbl Bedrrom	1.4	17	2.1	31	3	46
BH1 L01.04 Dbl Bedroom	1.4	20	2.2	32	2.9	48
BH1 L01.04 Single Bedroom	1.3	18	1.9	24	3.2	41
BH1 L01.04 Dbl Bedroom	1.1	20	2.2	32	2.9	48
BH1 L01.05 Dbl Bedroom	0.9	26	1.7	43	2.9	66
BH1 L01.05 Single Bedroom	0.8	20	1.7	33	2.9	51
BH1 L01.05 Single Bedroom	0.7	20	1.7	33	5.4	51
BH1 L01.05 Dbl Bedroom	0.7	26	1.7	43	3.3	66
BH1 L01.06 Twin Single Bedroom	0.5	19	1.3	28	3.4	44
BH1 L01.06 Twin Single Bedroom	0.5	19	1.3	28	5.5	44
BH1 L01.06 Dbl Bedroom	0.8	23	1.7	38	4.4	55
BH1 L01.06 Single Bedroom	0.9	20	1.8	33	2.8	50
BH1 L01.01 Living/Kitchen	2	N/A	3.4	N/A	2.7	N/A
BH2 L02.01 Living/Kitchen	2.3	N/A	3.7	N/A	2.9	N/A
BH1 L02.05 Living room	1.9	N/A	3.2	N/A	3.2	N/A
BH1 L02.05 Kitchen	1.7	N/A	3.1	N/A	3.2	N/A
BH1 L02.04 Living room	1.9	N/A	3.2	N/A	3	N/A
BH1 L02.04 Kitchen	1.7	N/A	3.1	N/A	2.9	N/A
BH1 L02.03 LivingRm	0.9	N/A	2.3	N/A	5.1	N/A
BH1 L02.01 Dbl Bedroom	1.3	21	2.1	30	5.1	54
BH1 L02.01 DBl Bedroom	1.6	21	2.1	30	4.8	54
BH1 L02.02 LivingRM	1.7	N/A	3.1	N/A	4.6	N/A
BH1 L02.02 F2 DBLBD2	1	N/A	1.9	N/A	4.9	N/A
BH1 L02.02 F2 SNGLBD	1.1	N/A	1.9	N/A	4.6	N/A
BH1 L02.02 DBLBD1	0.8	N/A	1.7	N/A	3.4	N/A
BH1 L02.03 Kitchen	0.9	N/A	2.5	N/A	3.3	N/A
BH1 L02.06 Kitchen	2.2	N/A	3.4	N/A	3.4	N/A
BH1 L02.06 Living room	2.8	N/A	4	N/A	5.5	N/A
BH1 L02.01 Living/Kitchen	1.9	N/A	3.3	N/A	4.4	N/A
BH2 L03.03 Kitchen	1.1	N/A	2.6	N/A	2.9	N/A
BH2 L03.03 Single Bedroom	0.9	16	1.7	25	3.3	38
BH2 L03.03 Dbl Bedroom	1	14	1.8	22	5.2	37
BH2 L03.03 Living room	1.2	N/A	2.6	N/A	5.8	N/A
BH2 L03.03 Dbl Bedroom	0.9	14	1.8	22	5	37
BH2 L03.04 Dbl Bedroom	1.1	22	1.9	29	3.6	46
BH2 L03.04 Living/Kitchen	1.6	N/A	3.1	N/A	2.6	N/A
BH2 L03.05 Single Bedroom	1.4	18	2	26	2.7	41
BH2 L03.05 Dbl Bedroom	1.4	20	2	27	3.8	44
BH2 L03.05 Living/Kitchen	2.6	N/A	3.9	N/A	2.8	N/A
BH1 L03.01 Dbl Bedroom	1.2	24	2.1	35	4.7	57
BH1 L03.01 Dbl Bedroom	1.4	24	2.1	35	3	57
BH1 L03.01 Living/Dining	1.6	N/A	3	N/A	3.1	N/A
BH1 L03.02 Kitchen	2.4	N/A	3.7	N/A	5.6	N/A
BH1 L03.02 Kitchen	1.8	N/A	3.7	N/A	3.1	N/A
BH1 L03.02 Dbl Bedroom	1.1	25	1.9	35	3.3	51
BH1 L03.02 Single Bedroom	1.2	24	2	33	4.8	46
BH1 L03.02 Dbl Bedroom	0.8	25	1.9	35	5.1	51
BH1 L03.03 Kitchen	1.1	N/A	2.5	N/A	4.4	N/A
BH1 L03.03 Single Bedroom	0.9	16	1.7	25	2.7	38
BH1 L03.03 Dbl Bedroom	1	14	1.8	22	2.9	37
BH1 L03.03 Living room	1.2	N/A	2.7	N/A	3.6	N/A

BH1 L03.03 Dbl Bedroom	1	14	1.8	22	2.6	37
BH1 L03.04 Dbl Bedroom	1.1	22	1.8	29	2.7	46
BH1 L03.04 Living/Kitchen	1.6	N/A	3	N/A	3.8	N/A
BH1 L03.05 Single Bedroom	1.4	18	2	26	2.8	41
BH1 L03.05 Dbl Bedroom	1.4	20	2	27	4.6	44
BH1 L03.05 Living/Kitchen	2.7	N/A	3.9	N/A	3	N/A
BH2 L03.01 Dbl Bedroom	1.5	24	2	36	3.1	57
BH2 L03.01 Dbl Bedroom	1.7	24	2	36	5.6	57
BH2 L03.01 Living/Dining	2.5	N/A	3.4	N/A	3.3	N/A
BH2 L03.02 Living	2.1	N/A	3.7	N/A	3.5	N/A
BH2 L03.02 Dbl Bedroom	1.2	24	1.9	36	5.8	55
BH2 L03.02 Single Bedroom	1.4	23	1.9	30	6.3	50
BH2 L03.02 Dbl Bedroom	1	24	1.9	36	5.4	55
BH2 L03.03 Kitchen	1.3	N/A	2.6	N/A	3	N/A
BH2 L03.03 Single Bedroom	1.5	16	1.7	25	3.1	38
BH2 L03.03 Dbl Bedroom	1.3	14	1.8	22	2.7	37
BH2 L03.03 Living room	1.4	N/A	2.6	N/A	4	N/A
BH2 L03.03 Dbl Bedroom	1.1	14	1.8	22	3.2	37
BH2 L03.04 Dbl Bedroom	1.4	22	1.9	29	3.1	46
BH2 L03.04 Living/Kitchen	2.4	N/A	3.1	N/A	4.5	N/A
BH1 L03.01 Dbl Bedroom	1.4	24	2.1	35	2.9	57
BH1 L03.01 Dbl Bedroom	1.6	24	2.1	35	3.1	57
BH1 L03.01 Living/Dining	2.3	N/A	3	N/A	5.3	N/A
BH1 L03.02 Kitchen	2	N/A	3.7	N/A	3.2	N/A
BH1 L03.02 Dbl Bedroom	1.2	25	1.9	35	3.2	51
BH1 L03.02 Single Bedroom	1.3	24	2	33	6.2	46
BH1 L03.02 Dbl Bedroom	1	25	1.9	35	3.4	51
BH1 L03.03 Kitchen	1.3	N/A	2.5	N/A	3.5	N/A
BH1 L03.03 Single Bedroom	1.5	16	1.7	25	5.5	38
BH1 L03.03 Dbl Bedroom	1.3	14	1.8	22	5.9	37
BH1 L03.03 Living room	1.4	N/A	2.7	N/A	4.7	N/A
BH1 L03.03 Dbl Bedroom	1.1	14	1.8	22	3	37
BH1 L03.04 Dbl Bedroom	1.4	22	1.8	29	3.1	46
BH1 L03.04 Living/Kitchen	2.4	N/A	3	N/A	2.7	N/A
BH1 L03.05 Single Bedroom	1.5	18	2	26	4	41
BH1 L03.05 Dbl Bedroom	1.5	20	2	27	3.2	44
BH1 L01.02 Kitchen diner	2.6	N/A	3.7	N/A	3.1	N/A
BH1 L02.02 Kitchen	2.6	N/A	3.7	N/A	4.5	N/A
BH2 L03.05 Single Bedroom	1.5	18	2	26	3.1	41
BH2 L03.05 Dbl Bedroom	1.5	20	2	27	5.3	44
BH2 L03.05 Living/Kitchen	3	N/A	3.9	N/A	3.2	N/A
BH1 L03.02 Kitchen	2.8	N/A	3.7	N/A	3.2	N/A
BH1 L03.05 Living/Kitchen	3	N/A	3.9	N/A	6.2	N/A

2020	DSY1		DSY2		DSY3	
Block H rooms with windows closed at night	Criteria a	Criteria b	Criteria a	Criteria b	Criteria a	Criteria b
Room Name	= < 3.0	< 33	= < 3.0	< 33	= < 3.0	< 33
BH2 L02.05 Kitchen	2.4	N/A	3.7	N/A	5.3	N/A
BH2 L02.04 Kitchen	2.5	N/A	3.7	N/A	5.3	N/A
BH2 L02.01 Dbl Bedroom	2	69	2.8	106	4.2	149
BH2 L02.01 DBl Bedroom	2	69	2.9	106	4.4	149
BH2 L01.01 DBLBED2	2.4	N/A	2.9	114	4.6	157
BH2 L01.01 DBLBED1	2.5	73	2.9	114	4.7	156
BH2 L03.01 Dbl Bedroom	1.9	71	2.9	105	4.2	153
BH2 L03.01 Dbl Bedroom	1.9	71	2.9	105	4.5	153
BH2 L03.01 Living/Dining	2.8	N/A	4.1	N/A	6.3	N/A
BH2 L02.06 Living room	3.1	N/A	4	N/A	6.1	N/A
BH2 L01.03 Dbl Bedroom	1.4	36	2.1	64	3.4	95
BH2 L01.04 Dbl Bedrrom	1.8	66	2.6	98	4	147
BH2 L01.04 Dbl Bedroom	1.8	62	2.5	95	3.9	136
BH2 L01.05 Dbl Bedroom	1.7	65	2.6	97	4	145
BH2 L01.05 Single Bedroom	1.7	58	2.5	92	3.8	133
BH2 L01.06 Dbl Bedroom	1.4	75	2.6	109	4	155
BH2 L01.06 Single Bedroom	1.7	85	3	112	4.7	161
BH2 L01.01 Living/Kitchen	3.3	N/A	4.4	N/A	6.6	N/A
BH1 L01.01 DBLBED2	2.2	72	2.8	108	4.4	158
BH1 L01.01 DBLBED1	2.2	71	2.8	107	4.3	157
BH1 L01.03 Dbl Bedroom	1.3	36	2.1	64	3.4	95
BH1 L01.04 Dbl Bedrrom	1.7	66	2.6	98	4	146
BH1 L01.04 Dbl Bedroom	1.8	63	2.5	96	3.9	138
BH1 L01.05 Dbl Bedroom	1.6	71	2.6	106	4	150
BH1 L01.05 Single Bedroom	1.3	61	2.5	96	3.7	140
BH1 L01.06 Dbl Bedroom	1.4	72	2.5	109	3.9	152
BH1 L01.06 Single Bedroom	1.5	62	2.6	101	3.9	141
BH1 L01.01 Living/Kitchen	2.9	N/A	4.1	N/A	6.3	N/A
BH2 L02.01 Living/Kitchen	3.1	N/A	4.2	N/A	6.5	N/A
BH1 L02.05 Kitchen	2.3	N/A	3.6	N/A	5.3	N/A
BH1 L02.04 Kitchen	2.5	N/A	3.7	N/A	5.3	N/A
BH1 L02.01 Dbl Bedroom	1.9	70	2.7	103	4.2	153
BH1 L02.01 DBl Bedroom	1.9	70	2.7	103	4.1	153
BH1 L02.06 Living room	3.2	N/A	4.1	N/A	6.3	N/A
BH1 L02.01 Living/Kitchen	2.8	N/A	4.1	N/A	6.1	N/A
BH2 L03.03 Single Bedroom	1.3	37	2.1	67	3.2	91
BH2 L03.03 Living room	1.4	N/A	3.1	N/A	4.6	N/A
BH2 L03.04 Living/Kitchen	2.1	N/A	3.5	N/A	5.1	N/A
BH2 L03.05 Living/Kitchen	3.1	N/A	4.2	N/A	6.4	N/A

2020	DSY1		DSY2		DSY3	
Block I	Criteria a	Criteria b	Criteria a	Criteria b	Criteria a	Criteria b
Room Name	= < 3.0	< 33	= < 3.0	< 33	= < 3.0	< 33
Double Bedroom 02.02	0.7	19	1.7	37	2.5	54
LDK 2bed 02.02	1.5	N/A	2.9	N/A	4.5	N/A
Double Bedroom 02.02	0.5	19	1.7	37	2.5	54
Dpuble Bedroom 02.05	0.5	23	1.5	39	2.1	60
LDK 2bed 02.05	1.6	N/A	2.9	N/A	4.3	N/A
LDK 1bed 07.02	2.4	N/A	3.6	N/A	5.8	N/A
Double Bedroom 07.03	1.3	17	2	28	3	45
LDK 2bed 07.03	2.3	N/A	3.6	N/A	5.2	N/A
Double Bedroom 07.04	1.3	14	2	21	3	38
LDK 1bed 07.04	2.2	N/A	3.8	N/A	5.6	N/A
LDK 1bed 07.01	2.1	N/A	3.6	N/A	5.4	N/A
Double Bedroom 07.01	1	17	1.8	27	2.8	42
Double Bedroom 02.01	1.1	19	1.8	29	2.8	44
Bathroom	1.9	N/A	2.9	N/A	4.5	N/A
LDK 1bed 02.01	1.7	N/A	3.1	N/A	4.7	N/A
Double Bedroom 02.06	1.1	17	1.8	27	2.8	43
LDK 1bed 02.06	1.4	N/A	3	N/A	4.6	N/A
Double Bedroom 02.05	0.7	22	1.6	38	2.5	55
Double Bedroom 07.04	1.8	14	2	21	3	38

2020	DSY1		DSY2		DSY3	
Block J windows openable at night	Criteria a	Criteria b	Criteria a	Criteria b	Criteria a	Criteria b
Room Name	= < 3.0	< 33	= < 3.0	< 33	= < 3.0	< 33
H15 Kitchen/Din	2.7	NA	4	NA	5.9	NA
GF H15 LivingRoom	0.8	NA	2.1	NA	3	NA
1F H15 SingleBed	0.9	19	1.7	35	2.5	45
2F H1 Kitchen/Din	2.2	NA	3.7	NA	5.4	NA
2F H1 LivingRoom	0.9	NA	2.6	NA	4.1	NA
3F H1 DoubleBed	0.9	19	1.9	29	2.7	39
3F H1 SingleBed	0.8	18	1.7	27	2.6	45
3F H1 DoubleBed	0.9	19	1.9	29	2.7	39
1F H15 DoubleBed	1	22	1.6	40	2.7	60
1F H15 DoubleBed	1	22	1.6	40	2.7	60
H6 Kitchen/Din	2.2	NA	3.7	NA	5.4	NA
GF H6 LivingRoom	0.7	NA	2.1	NA	2.7	NA
1F H6 SingleBed	0.7	16	1.5	27	2.6	47
1F H6 SingleBed	0.8	16	1.5	27	2.6	47
1F H6 DoubleBed	1	21	2	33	2.8	44
1F H6 DoubleBed	0.4	21	2	33	2.8	44
2F H6 DoubleBed	0.2	16	0.9	29	1.1	45
2F H6 SingleBed	0.5	16	1.4	27	2.1	43
1F H15 SingleBed	0.8	19	1.7	35	2.5	45

2020	DSY1		DSY2		DSY3	
Block J windows closed at night	Criteria a	Criteria b	Criteria a	Criteria b	Criteria a	Criteria b
Room Name	= < 3.0	< 33	= < 3.0	< 33	= < 3.0	< 33
H15 Kitchen/Din	3.8	NA	4.9	NA	7.1	NA
GF H15 LivingRoom	1.3	NA	3.1	NA	5.2	NA
1F H15 SingleBed	1.8	134	2.8	139	4.3	212
2F H1 Kitchen/Din	3.6	NA	5	NA	7.4	NA
2F H1 LivingRoom	2.1	NA	4.1	NA	6.5	NA
3F H1 DoubleBed	2.1	100	3.3	118	4.7	178
3F H1 SingleBed	1.9	110	3	134	4.5	196
3F H1 DoubleBed	2.1	100	3.1	118	4.7	178
1F H15 DoubleBed	1.7	80	2.5	116	4.2	168
1F H15 DoubleBed	1.7	80	2.9	116	4.3	168
H6 Kitchen/Din	3.3	NA	4.6	NA	6.9	NA
GF H6 LivingRoom	1	NA	2.7	NA	4	NA
1F H6 SingleBed	1.1	64	1.9	98	3.2	145
1F H6 SingleBed	1.1	64	2.3	98	3.6	145
1F H6 DoubleBed	1.7	75	2.7	106	3.9	152
1F H6 DoubleBed	1.7	75	2.2	106	3.5	152
2F H6 DoubleBed	1.4	104	3	127	4.7	186
2F H6 SingleBed	1.6	75	2.8	108	4.4	160
1F H15 SingleBed	1.8	134	2.6	139	3.9	212

Non-Domestic

The results of the assessment of the three criteria for the non-domestic elements of the detailed part of the application are shown below (using DSY 1).

Room Reference	Criterion 1: % Hours exceeding comfort range	Criterion 2: Maximum daily degree hours	Criterion 3: Maximum ΔT	Result
Target	**< 3**	**< 6**	**< 4**	
BF01 Retail	97.1	158	15	FAIL
BF02 Retail	98	159	17	FAIL
Marketing Suite 1 (2B4P)	75.9	121	14	FAIL
Marketing Suite 2 (Closing room)	9.6	17	3	FAIL
Marketing Suite 3 (BF04)	77.1	99	10	FAIL
Cafe	36.2	59	7	FAIL
BH1-01 Retail	97.2	126	14	FAIL
BH1-02 Retail	96.4	102	10	FAIL

Room Reference	Criterion 1: % Hours exceeding comfort range	Criterion 2: Maximum daily degree hours	Criterion 3: Maximum ΔT	Result
Target	< 3	< 6	< 4	
BH1-03 Retail	93.8	82	8	FAIL
BH1-04 Retail	87.0	61	6	FAIL
BH1-05 Retail	93.2	91	9	FAIL
BH1-06 Retail	92.6	81	8	FAIL
BH2-01 Retail	98.5	145	15	FAIL
BH2-02 Retail	97.3	106	11	FAIL
BH2-03 Retail	94.1	82	8	FAIL
BH2-04 Retail	83.6	53	5	FAIL
BH2-05 Retail	85.1	58	6	FAIL
BH2-06 Retail	88.9	62	6	FAIL
BH3-01 Retail	99.3	109	13	FAIL
BH3-02 Retail	86.7	76	10	FAIL
BH3-03 Retail	87.9	88	11	FAIL
BH3-04 Retail	89.6	94	12	FAIL

A.8.4 Outline Part of the Application Overheating Modelling Results

Domestic Dwellings – Recessed Balconies

The results of the assessment of criteria (a) and (b) for the sample residential dwellings in the outline part of the application using recessed balconies are shown below.

Apartment reference	Criterion (a): % Hours exceeding comfort range			Criterion (b): Operative temperature (°C) - hours in range		
	DSY 1	DSY 2	DSY 3	DSY 1	DSY 2	DSY 3
Target	< 3	< 3	< 3	< 33	< 33	< 33
E4.02.02 Living Kitchen	2.1	3.5	5.6	-	-	-
E4.02.02 Double Bed 1	0.4	1.2	1.6	11	21	35
E4.02.02 Double Bed 2	1.3	2.1	3.5	19	35	51
E4.08.02 Living Kitchen	2.9	3.8	6.2	-	-	-
E4.08.02 Double Bed 1	0.8	1.5	2.7	15	24	38

Apartment reference	Criterion (a): % Hours exceeding comfort range			Criterion (b): Operative temperature (°C) - hours in range		
	DSY 1	DSY 2	DSY 3	DSY 1	DSY 2	DSY 3
Target	< 3	< 3	< 3	< 33	< 33	< 33
E4.08.02 Double Bed 2	2.5	2.9	4.2	22	37	56
E1.14.06 Living Kitchen	3.7	4.8	6.9	-	-	-
E1.14.06 Double Bed 1	0.7	1.8	2.6	16	31	40
E1.14.06 Double Bed 2	2.2	2.5	3.8	19	33	47
E1.20.06 Living Kitchen	3.7	4.8	6.9	-	-	-
E1.20.06 Double Bed 1	0.8	1.8	2.7	17	30	40
E1.20.06 Double Bed 2	2.2	2.6	3.9	20	33	46
E1.02.08 Living Kitchen	1.5	3.0	4.6	-	-	-
E1.02.08 Double Bed	1.1	1.6	3	16	25	40
E1.08.08 Living Kitchen	1.9	3.3	5.1	-	-	-
E1.08.08 Double Bed	1.6	2.2	3.5	17	28	42
E1.14.08 Living Kitchen	2.1	3.4	5.5	-	-	-
E1.14.08 Double Bed	1.9	2.3	3.6	18	32	47
E1.20.08 Living Kitchen	2.2	3.5	5.6	-	-	-
E1.20.08 Double Bed	2.0	2.3	3.7	19	33	46
E1.14.02 Living Kitchen	3.3	4.2	6.7	-	-	-
E1.14.02 Double Bed 1	0.5	1.4	2.1	15	26	38
E1.14.02 Double Bed 2	0.7	1.6	2.4	17	30	45
E1.20.02 Living Kitchen	3.4	4.2	6.6	-	-	-
E1.20.02 Double Bed 1	0.5	1.4	2.2	15	27	41
E1.20.02 Double Bed 2	0.7	1.6	2.5	17	28	44

Domestic Dwellings – Projecting Balconies

The results of the assessment of criteria (a) and (b) for the sample residential dwellings in the outline part of the application using projecting balconies are shown below.

Apartment reference	Criterion (a): % Hours exceeding comfort range			Criterion (b): Operative temperature (°C) - hours in range		
	DSY 1	DSY 2	DSY 3	DSY 1	DSY 2	DSY 3
Target	< 3	< 3	< 3	< 33	< 33	< 33
E4.02.02 Living Kitchen	2.0	3.5	5.2	-	-	-
E4.02.02 Double Bed 1	0.4	1.3	1.7	11	23	32
E4.02.02 Double Bed 2	1.0	1.7	2.9	17	33	44
E4.08.02 Living Kitchen	3.7	4.5	6.8	-	-	-
E4.08.02 Double Bed 1	1.5	2.2	3.3	17	32	41
E4.08.02 Double Bed 2	3.1	3.2	4.6	24	38	57
E1.14.06 Living Kitchen	3.7	4.7	6.8	-	-	-
E1.14.06 Double Bed 1	0.9	1.8	2.7	17	27	38
E1.14.06 Double Bed 2	2.3	2.5	4	20	34	47
E1.20.06 Living Kitchen	4.3	5.2	7.6	-	-	-
E1.20.06 Double Bed 1	1.3	2.2	3.4	17	32	42
E1.20.06 Double Bed 2	2.7	3	4.4	22	35	52
E1.02.08 Living Kitchen	1.4	2.8	4.2	-	-	-
E1.02.08 Double Bed	0.9	1.4	2.6	12	23	31
E1.08.08 Living Kitchen	1.8	3.2	4.6	-	-	-
E1.08.08 Double Bed	1.3	2.0	3	13	23	32
E1.14.08 Living Kitchen	2.2	3.6	5.5	-	-	-
E1.14.08 Double Bed	1.8	2.2	3.5	17	27	38
E1.20.08 Living Kitchen	3.4	4.1	6.5	-	-	-
E1.20.08 Double Bed	2.3	2.5	3.8	18	30	42
E1.14.02 Living Kitchen	3.2	4.1	6.6	-	-	-
E1.14.02 Double Bed 1	0.7	1.6	2.4	17	32	43
E1.14.02 Double Bed 2	0.6	1.4	2.2	16	26	39
E1.20.02 Living Kitchen	3.5	4.2	6.7	-	-	-
E1.20.02 Double Bed 1	0.9	1.8	2.7	17	33	47
E1.20.02 Double Bed 2	0.8	1.5	2.5	17	29	41

Appendix A.9 - Drawings

ISO A1 841mm x 594mm

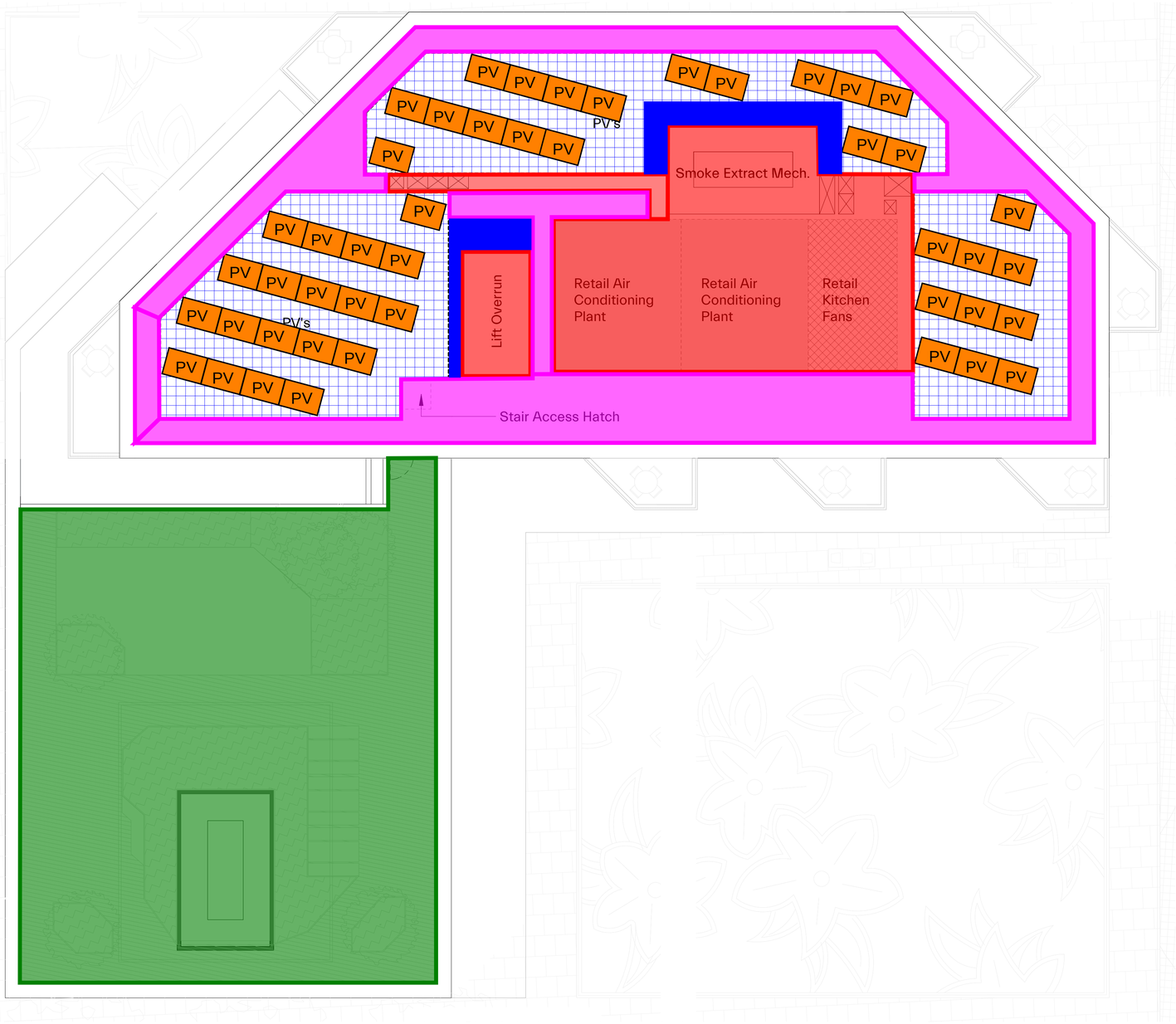
Maintenance Access Routes

Shaded Areas

Areas Available for PV

Amenity Space

Plant Areas / Services
Distribution Routes



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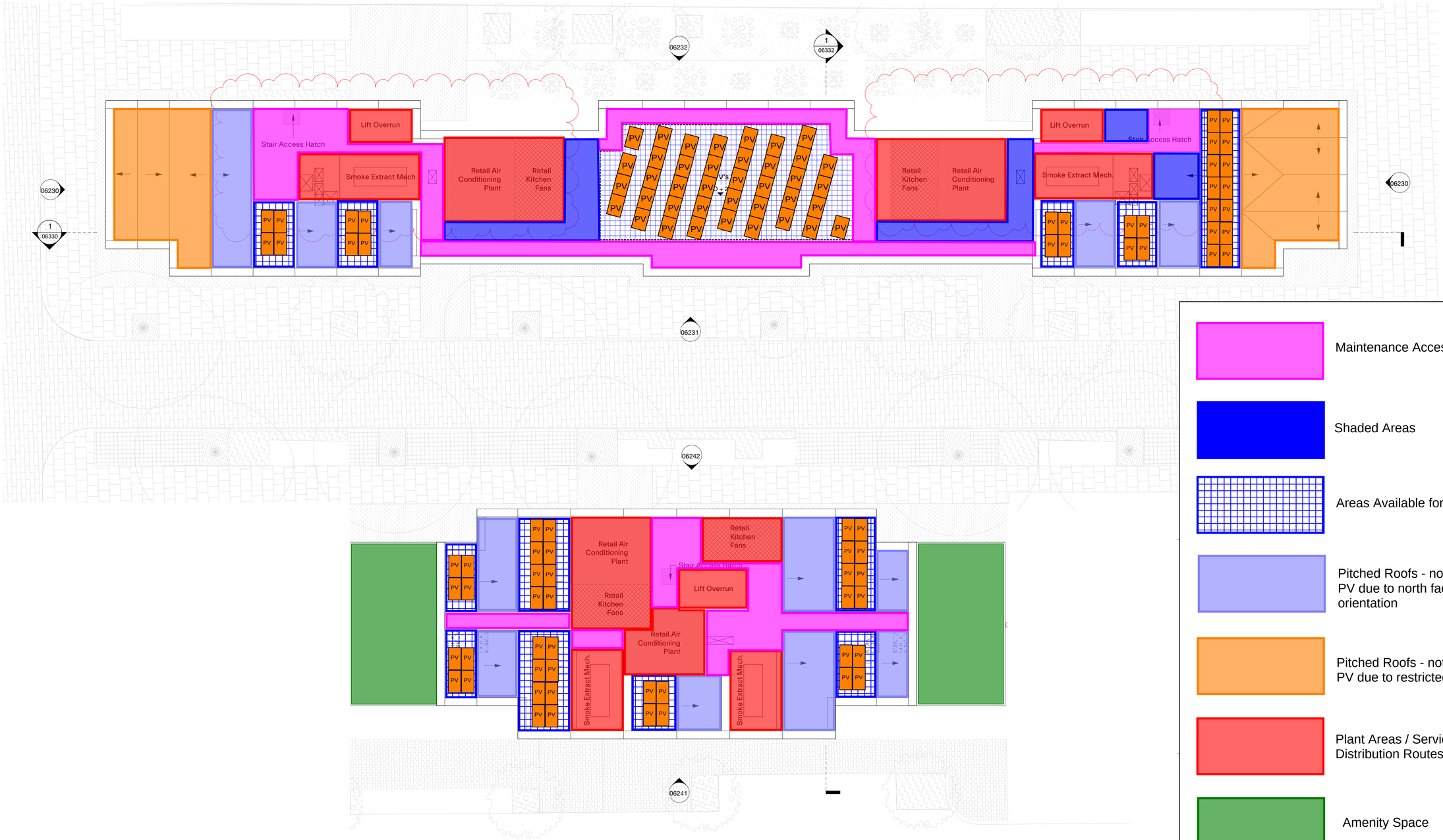
PROJECT: ABERFELDY VILLAGE MASTERPLAN	CLIENT: ECOWORLD & POPLAR HARCA	DISCIPLINE: MECHANICAL		DATE: 08/10/21	SCALE @ A1: 1:100
	TITLE: BLOCK F PV LAYOUT	DRAWN: SF	DESIGNED: RD	CHECKED: RD	APPROVED: RD
		DRAWING No: 2812-SK-001			ISSUE: P02



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FOR INFORMATION

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PROJECT
ABERFELDY VILLAGE MASTERPLAN

CLIENT
ECOWORLD & POPLAR HARCA

TITLE
BLOCK H PV LAYOUT

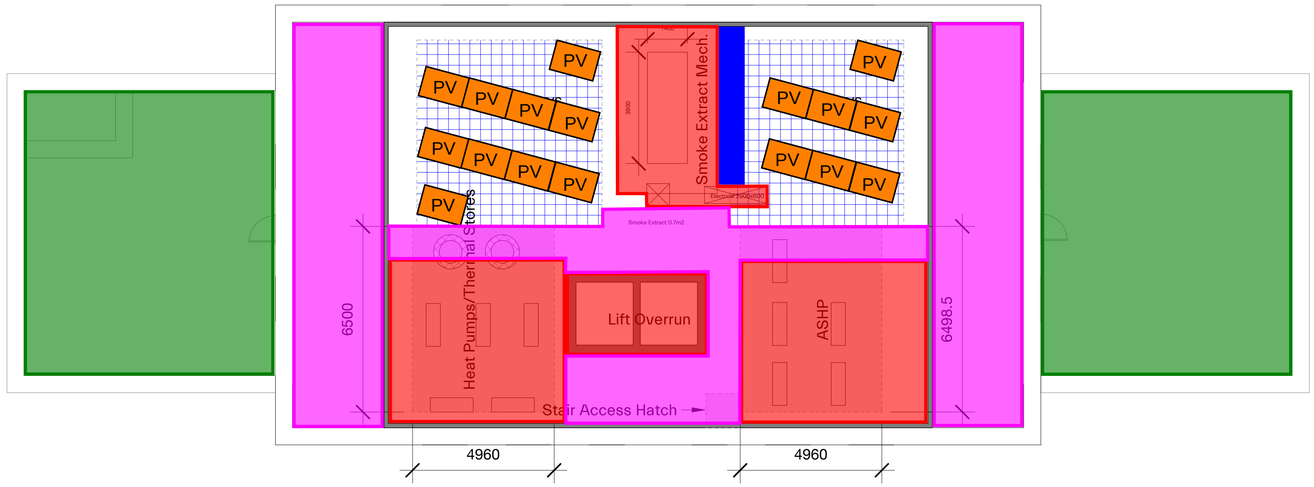
DISCIPLINE	DATE	SCALE @ A1
MECHANICAL	20/10/23	1:100

DRAWN	DESIGNED	CHECKED	APPROVED
WN	RD	RD	RD

DRAWING No
2812-SK-001

ISSUE
P04

ISO A1 841mm x 594mm



N

Maintenance Access Routes

Shaded Areas

Areas Available for PV

Amenity Space

Plant Areas / Services Distribution Routes

FOR INFORMATION

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PROJECT: ABERFELDY VILLAGE MASTERPLAN

CLIENT: ECOWORLD & POPLAR HARCA

TITLE: BLOCK I PV LAYOUT

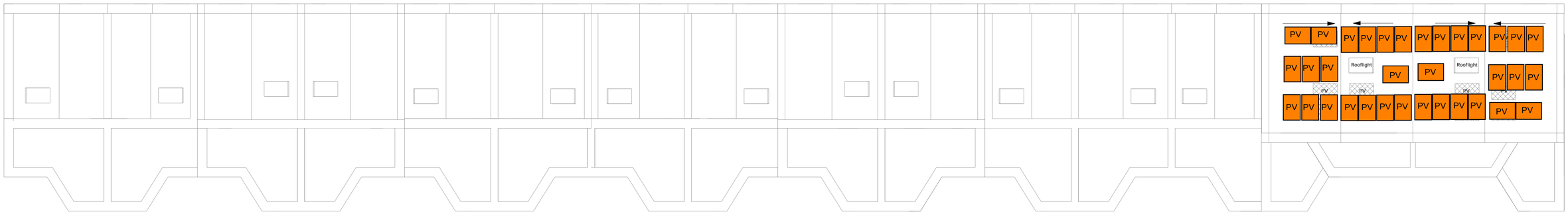
DISCIPLINE	DATE	SCALE @ A1
MECHANICAL	08/10/21	1:100

DRAWN	DESIGNED	CHECKED	APPROVED
SF	RD	RD	RD

DRAWING No: 2812-SK-003

ISSUE: P02

ISO A1 841mm x 594mm



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PROJECT
ABERFELDY VILLAGE
MASTERPLAN

CLIENT
ECOWORLD & POPLAR HARCA

TITLE
BLOCK J1 PV LAYOUT

DISCIPLINE	DATE	SCALE @ A1
MECHANICAL	08/10/21	1:100

DRAWN	DESIGNED	CHECKED	APPROVED
SF	RD	RD	RD

DRAWING No
2812-SK-004

ISSUE
P01

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Full SAP Calculation Printout

Property Reference	13, 07 x2_Copy_Copy_Copy	Issued on Date	12/09/2023
Assessment Reference	13, 07 x2_Copy_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	9.45	TER	9.59
Environmental	90 B	% DER < TER			1.46
CO_2 Emissions (t/year)	1.28	DFEE	30.72	TFEE	37.91
Compliance Check	See BREL	% DFEE < TFEE			18.97
% DPER < TPER	-8.11	DPER	54.20	TPER	50.13

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.1000 (1b)	x	2.7300 (2b)	=	166.8030 (1b)	-
First floor	62.1000 (1c)	x	2.9600 (2c)	=	183.8160 (1c)	-
Second floor	39.1000 (1d)	x	3.0200 (2d)	=	118.0820 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	162.3000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	468.7010	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	45.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4376	0.4344	0.4312	0.4153	0.4121	0.3961	0.3961	0.3929	0.4025	0.4121	0.4184	0.4248	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 0.80)			26.0900	0.7752	20.2248			(27)
front door			2.0000	1.0000	2.0000			(26)
Heatloss Floor 1			61.1000	0.0800	4.8880	110.0000	6721.0000	(28a)
exposed floor			1.6800	0.0800	0.1344			(28b)
External Wall 1	128.0622	28.0900	99.9722	0.1300	12.9964	190.0000	18994.7180	(29a)
External Roof 1	41.2700		41.2700	0.1000	4.1270	9.0000	371.4300	(30)
External Roof 2	19.2300		19.2300	0.1000	1.9230	9.0000	173.0700	(30)
Total net area of external elements Aum(A, m2)			251.3422					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.2936			(33)
Party Wall 1			114.0000	0.0000	0.0000	180.0000	20520.0000	(32)
Internal Wall 1			330.5300			9.0000	2974.7700	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	49754.9880 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		306.5618 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	16.9600	0.0500	0.8480
E3 Sill	15.7600	0.0500	0.7880
E4 Jamb	40.5800	0.0500	2.0290
E5 Ground floor (normal)	13.4000	0.1600	2.1440
E6 Intermediate floor within a dwelling	13.4000	0.0000	0.0000
E20 Exposed floor (normal)	1.8000	0.3200	0.5760
E13 Gable (insulation at rafter level)	12.0000	0.0800	0.9600
R5 Ridge (inverted)	6.5500	0.0400	0.2620
P1 Party wall - Ground floor	20.4500	0.0800	1.6360
P4 Party wall - Roof (insulation at ceiling level)	27.7000	0.1200	3.3240
E14 Flat roof	9.2300	0.0800	0.7384
P2 Party wall - Intermediate floor within a dwelling	21.0000	0.0000	0.0000
R7 Flat ceiling (inverted)	5.6500	0.0400	0.2260
E16 Corner (normal)	17.8800	0.0900	1.6092
E18 Party wall between dwellings	36.6000	0.0600	2.1960
R4 Ridge (vaulted ceiling)	6.5500	0.0800	0.5240

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	17.8606 (36)
Point Thermal bridges (36a) =	0.0000
Total fabric heat loss (33) + (36) + (36a) =	64.1542 (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	67.6784	67.1854	66.6923	64.2273	63.7343	61.2692	61.2692	60.7762	62.2552	63.7343	64.7203	65.7063	(38)
Heat transfer coeff	131.8326	131.3396	130.8465	128.3815	127.8884	125.4234	125.4234	124.9304	126.4094	127.8884	128.8745	129.8605	(39)

Average = Sum(39)m / 12 = 128.2582

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8123	0.8092	0.8062	0.7910	0.7880	0.7728	0.7728	0.7697	0.7789	0.7880	0.7941	0.8001	(40)
HLP (average)												0.7903	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9521 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	101.3610	99.8377	97.6180	93.3710	90.2369	86.7417	84.7550	86.9579	89.3727	93.1255	97.4637	100.9726	(42a)
Hot water usage for baths	31.8240	31.3513	30.6858	29.4586	28.5397	27.5208	26.9704	27.6313	28.3509	29.4412	30.6937	31.7164	(42b)
Hot water usage for other uses	44.8626	43.2312	41.5998	39.9685	38.3371	36.7057	36.7057	38.3371	39.9685	41.5998	43.2312	44.8626	(42c)
Average daily hot water use (litres/day)												163.7414	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	178.0475	174.4202	169.9036	162.7981	157.1137	150.9682	148.4312	152.9264	157.6921	164.1665	171.3885	177.5516	(44)
Energy conte	281.9837	248.3721	261.1355	222.8625	211.5052	185.6331	179.5147	189.3548	194.4501	222.7724	244.1744	278.0028	(45)
Energy content (annual)											Total = Sum(45)m =	2719.7613	
Distribution loss (46)m = 0.15 x (45)m	42.2976	37.2558	39.1703	33.4294	31.7258	27.8450	26.9272	28.4032	29.1675	33.4159	36.6262	41.7004	(46)

Water storage loss:	
Store volume	300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	2.1100 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	1.1394 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(56)
If cylinder contains dedicated solar storage	35.3214	31.9032	35.3214	34.1820	35.3214	34.1820	35.3214	35.3214	34.1820	35.3214	34.1820	35.3214	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	340.5675	301.2865	318.3236	272.8029	257.2947	229.7203	225.0715	235.8421	245.7413	279.9605	300.8684	336.5866	(62)
WWHRS	-76.8882	-68.0006	-71.2063	-58.9616	-54.9501	-47.0212	-44.0749	-46.8692	-48.6500	-57.3529	-64.9739	-75.4644	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)

Aperture area of solar collector	0.9900 (H1)
Zero-loss collector efficiency	0.8000 (H2)
Overshading factor	1.0000 (H8)
Overall heat loss coefficient of system	5.4950 (H10)
Heat loss coefficient of collector loop	9.0505 (H11)
Dedicated solar storage volume	180.0000 (H12)
Effective solar volume	180.0000 (H14)
Reference volume	74.2500 (H15)
Storage tank correction coefficient	0.8014 (H16)
Heat delivered to hot water	205.5996 (H24)
Heat delivered to space heating	0.0000 (H29)

Solar input											205.5996	
Solar input	-0.0000	-0.0000	-12.5962	-26.2957	-41.9783	-40.4352	-39.6432	-30.3119	-14.3390	-0.0000	-0.0000	-0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h												
	263.6793	233.2859	234.5211	187.5455	160.3663	142.2639	141.3534	158.6610	182.7523	222.6075	235.8945	261.1222 (64)
										Total per year (kWh/year) = Sum(64)m =		2424.0530 (64)
12Total per year (kWh/year)												2424 (64)
Electric shower(s)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000 (64a)
Heat gains from water heating, kWh/month												
	140.6266	124.9152	132.5780	114.0541	106.9571	96.9928	96.1341	100.1503	105.6876	119.8223	126.5432	139.3030 (65)

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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	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	175.3892	194.1809	175.3892	181.2355	175.3892	181.2355	175.3892	175.3892	181.2355	175.3892	181.2355	175.3892	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	333.6109	337.0727	328.3490	309.7772	286.3337	264.3001	249.5803	246.1185	254.8422	273.4140	296.8575	318.8911	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	(71)
Water heating gains (Table 5)													
	189.0143	185.8858	178.1963	158.4085	143.7595	134.7122	129.2125	134.6107	146.7883	161.0514	175.7544	187.2352	(72)
Total internal gains													
	768.2960	787.4211	752.2161	719.7029	675.7641	647.5296	621.4637	623.4001	650.1477	680.1363	724.1291	751.7971	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.9200	10.6334	0.5000	0.8000	0.7700	32.1875	(74)
South	11.5200	46.7521	0.5000	0.8000	0.7700	149.2954	(78)
Southwest	3.6500	36.7938	0.5000	0.8000	0.7700	37.2273	(79)

Solar gains	218.7102	369.4313	502.7459	627.4120	713.4018	714.6767	686.2182	619.9246	544.9732	407.0298	261.2631	187.6969	(83)
Total gains	987.0063	1156.8523	1254.9620	1347.1149	1389.1659	1362.2063	1307.6819	1243.3247	1195.1209	1087.1661	985.3922	939.4940	(84)

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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, n1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	104.8362	105.2298	105.6263	107.6544	108.0694	110.1934	110.1934	110.6283	109.3339	108.0694	107.2426	106.4283	
alpha	7.9891	8.0153	8.0418	8.1770	8.2046	8.3462	8.3462	8.3752	8.2889	8.2046	8.1495	8.0952	
util living area													
	0.9991	0.9964	0.9875	0.9432	0.8109	0.5863	0.4218	0.4618	0.7145	0.9586	0.9965	0.9994	(86)
MIT	20.2815	20.4311	20.6107	20.8323	20.9627	20.9976	20.9999	20.9997	20.9891	20.8292	20.5201	20.2639	(87)
Th 2	20.2427	20.2453	20.2480	20.2611	20.2638	20.2770	20.2770	20.2796	20.2717	20.2638	20.2585	20.2532	(88)
util rest of house													
	0.9987	0.9950	0.9826	0.9230	0.7617	0.5216	0.3526	0.3897	0.6461	0.9393	0.9949	0.9991	(89)
MIT 2	19.5830	19.7341	19.9132	20.1335	20.2417	20.2761	20.2769	20.2796	20.2669	20.1364	19.8344	19.5745	(90)
Living area fraction										fLA = Living area / (4) =		0.1348	(91)
MIT	19.6772	19.8281	20.0072	20.2277	20.3389	20.3733	20.3744	20.3766	20.3643	20.2298	19.9268	19.6674	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6772	19.8281	20.0072	20.2277	20.3389	20.3733	20.3744	20.3766	20.3643	20.2298	19.9268	19.6674	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9940	0.9807	0.9219	0.7670	0.5303	0.3620	0.3995	0.6550	0.9383	0.9940	0.9989	(94)
Useful gains	985.3919	1149.8814	1230.6829	1241.9120	1065.5031	722.3705	473.3361	496.6664	782.8536	1020.0468	979.4669	938.4274	(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													
	2027.2119	1960.6476	1767.3757	1454.2629	1104.8197	724.1128	473.3988	496.8038	791.8625	1231.5352	1653.0477	2008.6047	(97)
Space heating kWh													
	775.1141	544.8349	399.2995	152.8926	29.2515	0.0000	0.0000	0.0000	0.0000	157.3474	484.9782	796.2120	(98a)
Space heating requirement - total per year (kWh/year)												3339.9301	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													

	775.1141	544.8349	399.2995	152.8926	29.2515	0.0000	0.0000	0.0000	0.0000	157.3474	484.9782	796.2120 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3339.9301
Space heating per m2											(98c) / (4) =	20.5787 (99)

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 %)												84.5000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	775.1141	544.8349	399.2995	152.8926	29.2515	0.0000	0.0000	0.0000	0.0000	157.3474	484.9782	796.2120	(98)
Space heating efficiency (main heating system 1)													
	84.5000	84.5000	84.5000	84.5000	84.5000	0.0000	0.0000	0.0000	0.0000	84.5000	84.5000	84.5000	(210)
Space heating fuel (main heating system)													
	917.2948	644.7750	472.5438	180.9380	34.6172	0.0000	0.0000	0.0000	0.0000	186.2099	573.9387	942.2627	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	263.6793	233.2859	234.5211	187.5455	160.3663	142.2639	141.3534	158.6610	182.7523	222.6075	235.8945	261.1222	(64)
Efficiency of water heater												89.5000	(216)
(217)m	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	(217)
Fuel for water heating, kWh/month													
	312.0465	276.0780	277.5397	221.9474	189.7826	168.3597	167.2822	187.7645	216.2749	263.4409	279.1650	309.0204	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	38.6919	34.9475	38.6919	37.4438	38.6919	37.4438	38.6919	38.6919	37.4438	38.6919	37.4438	38.6919	(231)
Lighting	32.2215	25.8493	23.2744	17.0518	13.1713	10.7611	12.0153	15.6180	20.2862	26.6166	30.0634	33.1170	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3952.5800	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												89.5000	
Water heating fuel used												2868.7018	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7250)													
mechanical ventilation fans (SFP = 0.7250)												414.5660	(230a)
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												455.5660	(231)
Electricity for lighting (calculated in Appendix L)												260.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												7536.8938	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3952.5800	0.2100	830.0418	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2868.7018	0.2100	602.4274	(264)
Space and water heating			1432.4692	(265)
Pumps, fans and electric keep-hot	455.5660	0.1387	63.1926	(267)
Energy for lighting	260.0461	0.1443	37.5327	(268)
Total CO2, kg/year			1533.1945	(272)

EPC Dwelling Carbon Dioxide Emission Rate (DER) 9.4500 (273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3952.5800	1.1300	4466.4154	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2868.7018	1.1300	3241.6330	(278)
Space and water heating			7708.0484	(279)
Pumps, fans and electric keep-hot	455.5660	1.5128	689.1803	(281)
Energy for lighting	260.0461	1.5338	398.8673	(282)
Total Primary energy kWh/year			8796.0960	(286)
Dwelling Primary energy Rate (DPER)			54.2000	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.1000 (1b)	x	2.7300 (2b)	=	166.8030 (1b)	-
First floor	62.1000 (1c)	x	2.9600 (2c)	=	183.8160 (1c)	-
Second floor	39.1000 (1d)	x	3.0200 (2d)	=	118.0820 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	162.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	468.7010	(5)

2. Ventilation rate

	m3 per hour			
Number of open chimneys	0	* 80 =	0.0000	(6a)
Number of open flues	0	* 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0	* 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0	* 20 =	0.0000	(6d)
Number of flues attached to other heater	0	* 35 =	0.0000	(6e)
Number of blocked chimneys	0	* 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0853	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3353	(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) =		0.2850	(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	0.3634	0.3563	0.3492	0.3135	0.3064	0.2708	0.2708	0.2637	0.2850	0.3064	0.3207	0.3349	(22b)
Effective ac	0.5660	0.5635	0.5610	0.5492	0.5469	0.5367	0.5367	0.5348	0.5406	0.5469	0.5514	0.5561	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.20)			26.0900	1.1450	29.8740			(27)
Heatloss Floor 1			61.1000	0.1300	7.9430			(28a)
exposed floor			1.6800	0.1300	0.2184			(28b)
External Wall 1	128.0622	28.0900	99.9722	0.1800	17.9950			(29a)
External Roof 1	41.2700		41.2700	0.1100	4.5397			(30)
External Roof 2	19.2300		19.2300	0.1100	2.1153			(30)

Total net area of external elements Aum(A, m2)	251.3422				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	64.6854			(33)
Party Wall 1	114.0000	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 306.5618 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	16.9600	0.0500	0.8480	
E3 Sill	15.7600	0.0500	0.7880	
E4 Jamb	40.5800	0.0500	2.0290	
E5 Ground floor (normal)	13.4000	0.1600	2.1440	
E6 Intermediate floor within a dwelling	13.4000	0.0000	0.0000	
E20 Exposed floor (normal)	1.8000	0.3200	0.5760	
E13 Gable (insulation at rafter level)	12.0000	0.0800	0.9600	
R5 Ridge (inverted)	6.5500	0.0400	0.2620	
P1 Party wall - Ground floor	20.4500	0.0800	1.6360	
P4 Party wall - Roof (insulation at ceiling level)	27.7000	0.1200	3.3240	
E14 Flat roof	9.2300	0.0800	0.7384	
P2 Party wall - Intermediate floor within a dwelling	21.0000	0.0000	0.0000	
R7 Flat ceiling (inverted)	5.6500	0.0400	0.2260	
E16 Corner (normal)	17.8800	0.0900	1.6092	
E18 Party wall between dwellings	36.6000	0.0600	2.1960	
R4 Ridge (vaulted ceiling)	6.5500	0.0800	0.5240	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.8606	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	82.5460	(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	87.5501	87.1535	86.7647	84.9386	84.5969	83.0064	83.0064	82.7119	83.6191	84.5969	85.2881	86.0107	(38)
Heat transfer coeff	170.0961	169.6995	169.3107	167.4846	167.1430	165.5525	165.5525	165.2579	166.1651	167.1430	167.8341	168.5567	(39)
Average = Sum(39)m / 12 =												167.4830	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0480	1.0456	1.0432	1.0319	1.0298	1.0200	1.0200	1.0182	1.0238	1.0298	1.0341	1.0386	(40)
HLP (average)												1.0319	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9521	(42)
Hot water usage for mixer showers	73.7171	72.6092	70.9949	67.9062	65.6268	63.0849	61.6400	63.2421	64.9983	67.7276	70.8827	73.4346	(42a)
Hot water usage for baths	31.8240	31.3513	30.6858	29.4586	28.5397	27.5208	26.9704	27.6313	28.3509	29.4412	30.6937	31.7164	(42b)
Hot water usage for other uses	44.8626	43.2312	41.5998	39.9685	38.3371	36.7057	36.7057	38.3371	39.9685	41.5998	43.2312	44.8626	(42c)
Average daily hot water use (litres/day)												138.2546	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.4036	147.1918	143.2805	137.3333	132.5036	127.3114	125.3162	129.2106	133.3177	138.7687	144.8075	150.0136	(44)
Energy conte	238.2025	209.5991	220.2168	188.0024	178.3754	156.5442	151.5591	159.9897	164.3941	188.3078	206.3049	234.8850	(45)
Energy content (annual)										Total = Sum(45)m =		2296.3810	
Distribution loss (46)m = 0.15 x (45)m	35.7304	31.4399	33.0325	28.2004	26.7563	23.4816	22.7339	23.9985	24.6591	28.2462	30.9457	35.2328	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1127	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.1409	(55)
Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	296.8313	262.5542	278.8457	244.7400	237.0042	213.2818	210.1879	218.6185	221.1317	246.9366	263.0424	293.5138	(62)
WWHRS	-33.7004	-29.8049	-31.2099	-25.8431	-24.0848	-20.6095	-19.3182	-20.5429	-21.3234	-25.1380	-28.4783	-33.0763	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	263.1310	232.7493	247.6357	218.8969	212.9194	192.6722	190.8697	198.0756	199.8082	221.7986	234.5642	260.4375	(64)
										Total per year (kWh/year) = Sum(64)m =		2673.5583	(64)
12Total per year (kWh/year)												2674	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	126.1054	112.0558	120.1251	107.9008	106.2129	97.4410	97.2964	100.0996	100.0511	109.5154	113.9864	125.0023	(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	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	175.3892	194.1809	175.3892	181.2355	175.3892	181.2355	175.3892	175.3892	181.2355	175.3892	181.2355	175.3892 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	333.6109	337.0727	328.3490	309.7772	286.3337	264.3001	249.5803	246.1185	254.8422	273.4140	296.8575	318.8911 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845 (71)
Water heating gains (Table 5)												
	169.4965	166.7496	161.4585	149.8623	142.7592	135.3347	130.7748	134.5425	138.9598	147.1981	158.3145	168.0139 (72)
Total internal gains												
	748.7783	768.2849	735.4784	711.1567	674.7638	648.1520	623.0260	623.3319	642.3192	666.2829	706.6891	732.5758 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.9200	10.6334	0.6300	0.7000	0.7700	35.4868	(74)
South	11.5200	46.7521	0.6300	0.7000	0.7700	164.5982	(78)
Southwest	3.6500	36.7938	0.6300	0.7000	0.7700	41.0431	(79)

Solar gains	241.1280	407.2980	554.2773	691.7217	786.5255	787.9311	756.5555	683.4669	600.8330	448.7503	288.0426	206.9358 (83)
Total gains	989.9063	1175.5829	1289.7557	1402.8784	1461.2893	1436.0831	1379.5815	1306.7988	1243.1522	1115.0333	994.7318	939.5116 (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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	81.2530	81.4430	81.6300	82.5200	82.6887	83.4831	83.4831	83.6319	83.1753	82.6887	82.3482	81.9951	
alpha	6.4169	6.4295	6.4420	6.5013	6.5126	6.5655	6.5655	6.5755	6.5450	6.5126	6.4899	6.4663	
util living area	0.9992	0.9975	0.9924	0.9699	0.8921	0.7086	0.5242	0.5747	0.8299	0.9794	0.9977	0.9995	(86)
MIT	19.9461	20.1119	20.3306	20.6200	20.8568	20.9760	20.9970	20.9948	20.9344	20.6311	20.2353	19.9210	(87)
Th 2	20.0435	20.0455	20.0475	20.0568	20.0585	20.0667	20.0667	20.0682	20.0635	20.0585	20.0550	20.0513	(88)
util rest of house	0.9989	0.9964	0.9891	0.9562	0.8466	0.6186	0.4152	0.4623	0.7524	0.9673	0.9966	0.9992	(89)
MIT 2	18.8097	19.0234	19.3033	19.6708	19.9414	20.0544	20.0659	20.0666	20.0227	19.6905	19.1890	18.7835	(90)
Living area fraction									fLA = Living area / (4) =			0.1348	(91)
MIT	18.9629	19.1701	19.4418	19.7988	20.0648	20.1787	20.1914	20.1918	20.1456	19.8173	19.3301	18.9369	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9629	19.1701	19.4418	19.7988	20.0648	20.1787	20.1914	20.1918	20.1456	19.8173	19.3301	18.9369	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9950	0.9862	0.9515	0.8470	0.6300	0.4300	0.4775	0.7600	0.9631	0.9953	0.9988	(94)
Useful gains	988.3169	1169.7516	1271.9530	1334.7906	1237.6831	904.7300	593.2186	624.0117	944.8037	1073.8950	990.0543	938.4241	(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	2494.1068	2421.6330	2191.1884	1825.3767	1398.1201	923.5656	594.5677	626.6188	1004.5751	1540.6124	2052.6263	2484.0006	(97)
Space heating kWh	1120.3077	841.2643	683.9111	353.2219	119.3651	0.0000	0.0000	0.0000	0.0000	347.2378	765.0519	1149.9089	(98a)
Space heating requirement - total per year (kWh/year)												5380.2687	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1120.3077	841.2643	683.9111	353.2219	119.3651	0.0000	0.0000	0.0000	0.0000	347.2378	765.0519	1149.9089	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5380.2687	
Space heating per m2											(98c) / (4) =	33.1501	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1120.3077	841.2643	683.9111	353.2219	119.3651	0.0000	0.0000	0.0000	0.0000	347.2378	765.0519	1149.9089	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)

Space heating fuel (main heating system)												
	1213.7678	911.4457	740.9655	382.6890	129.3230	0.0000	0.0000	0.0000	0.0000	376.2056	828.8753	1245.8385 (211)
Space heating efficiency (main heating system 2)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)												
	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												
	263.1310	232.7493	247.6357	218.8969	212.9194	192.6722	190.8697	198.0756	199.8082	221.7986	234.5642	260.4375 (64)
Efficiency of water heater												79.8000 (216)
(217)m	86.9351	86.6814	86.2152	85.1267	82.8151	79.8000	79.8000	79.8000	79.8000	85.0607	86.5105	86.9883 (217)
Fuel for water heating, kWh/month												
	302.6751	268.5112	287.2299	257.1425	257.1020	241.4439	239.1851	248.2150	250.3863	260.7533	271.1395	299.3936 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	36.4424	29.2355	26.3233	19.2856	14.8967	12.1708	13.5893	17.6639	22.9436	30.1033	34.0016	37.4553 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-56.5382	-79.3842	-113.6034	-127.0728	-136.3602	-126.9068	-125.2088	-118.4602	-106.5571	-90.3389	-61.9913	-48.9078 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	-32.9242	-69.1527	-137.2971	-206.0462	-272.3588	-273.7462	-270.6513	-229.3076	-168.1842	-98.9902	-43.9778	-26.0546 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												5829.1102 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												3183.1773 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												294.1111 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-3020.0206 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												6372.3780 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5829.1102	0.2100	1224.1131	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3183.1773	0.2100	668.4672	(264)
Space and water heating			1892.5804	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	294.1111	0.1443	42.4493	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1191.3297	0.1347	-160.4827	
PV Unit electricity exported	-1828.6909	0.1259	-230.2470	
Total			-390.7298	(269)
Total CO2, kg/year			1556.2292	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.5900	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5829.1102	1.1300	6586.8945	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3183.1773	1.1300	3596.9903	(278)
Space and water heating			10183.8848	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	294.1111	1.5338	451.1175	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1191.3297	1.4979	-1784.4552	

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PV Unit electricity exported	-1828.6909	0.4622	-845.1641
Total			-2629.6193 (283)
Total Primary energy kWh/year			8135.4838 (286)
Target Primary Energy Rate (TPER)			50.1300 (287)

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Property Reference	BH1 L01-6 02 x6_Copy_Copy	Issued on Date	12/09/2023
Assessment Reference	BH1 L01 02_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	10.18	TER	11.27
Environmental	91 B	% DER < TER			9.67
CO_2 Emissions (t/year)	0.89	DFEE	27.71	TFEE	27.09
Compliance Check	See BREL	% DFEE < TFEE			-2.27
% DPER < TPER	2.12	DPER	53.56	TPER	54.72

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	99.7000 (1b)	x	2.7400 (2b)	=	273.1780 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	99.7000				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		273.1780 (5)	

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.8000 (23c)

Effective ac	0.2986	0.2954	0.2922	0.2762	0.2731	0.2571	0.2571	0.2539	0.2635	0.2731	0.2794	0.2858	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.30)			20.4500	1.2357	25.2709			(27)
External Wall 1	66.4998	20.4500	46.0498	0.1400	6.4470	190.0000	8749.4620	(29a)
Total net area of external elements Aum(A, m2)			66.4998					(31)

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Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	31.7179			(33)
Party Wall 1	66.4700	0.0000	0.0000	180.0000	11964.6000 (32)
Party Floor 1	99.7000			40.0000	3988.0000 (32d)
Party Ceiling 1	99.7000			30.0000	2991.0000 (32b)
Internal Wall 1	176.5300			75.0000	13239.7500 (32c)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =				40932.8120 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					410.5598 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total	
E2	Other lintels (including other steel lintels)	11.4100	0.0300	0.3423	
E3	Sill	7.9000	0.0300	0.2370	
E4	Jamb	24.9000	0.0300	0.7470	
E7	Party floor between dwellings (in blocks of flats)	48.5400	0.0700	3.3978	
E8	Balcony within a dwelling, wall insulation continuous	6.6000	0.0000	0.0000	
E16	Corner (normal)	5.4800	0.0900	0.4932	
E18	Party wall between dwellings	5.4800	0.0600	0.3288	
E17	Corner (inverted - internal area greater than external area)	2.7400	0.0000	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		5.5461	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	37.2640	(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	26.9150	26.6277	26.3403	24.9036	24.6162	23.1795	23.1795	22.8921	23.7542	24.6162	25.1909	25.7656	(38)
Heat transfer coeff	64.1790	63.8917	63.6043	62.1676	61.8802	60.4435	60.4435	60.1561	61.0182	61.8802	62.4549	63.0296	(39)
Average = Sum(39)m / 12 =												62.0957	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6437	0.6408	0.6380	0.6235	0.6207	0.6063	0.6063	0.6034	0.6120	0.6207	0.6264	0.6322	(40)
HLP (average)												0.6228	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7367	(42)
Hot water usage for mixer showers	96.3954	94.9468	92.8359	88.7969	85.8163	82.4924	80.6030	82.6980	84.9945	88.5634	92.6891	96.0261	(42a)
Hot water usage for baths	31.8642	31.3910	30.7246	29.4958	28.5758	27.5556	27.0045	27.6663	28.3868	29.4784	30.7325	31.7565	(42b)
Hot water usage for other uses	44.9020	43.2692	41.6364	40.0036	38.3708	36.7380	36.7380	38.3708	40.0036	41.6364	43.2692	44.9020	(42c)
Average daily hot water use (litres/day)												159.2365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	173.1616	169.6069	165.1968	158.2964	152.7629	146.7859	144.3455	148.7350	153.3848	159.6782	166.6907	172.6846	(44)
Energy conte	274.2457	241.5180	253.9013	216.6998	205.6482	180.4904	174.5734	184.1650	189.1388	216.6818	237.4815	270.3823	(45)
Energy content (annual)										Total = Sum(45)m =		2644.9263	
Distribution loss (46)m = 0.15 x (45)m	41.1368	36.2277	38.0852	32.5050	30.8472	27.0736	26.1860	27.6248	28.3708	32.5023	35.6222	40.5573	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	329.5225	291.4455	309.1781	270.1935	260.9250	233.9841	229.8502	239.4418	242.6325	271.9586	290.9751	325.6591	(62)
WWHRS	-73.1216	-64.6693	-67.7180	-56.0732	-52.2582	-44.7177	-41.9157	-44.5732	-46.2667	-54.5433	-61.7909	-71.7675	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	256.4009	226.7761	241.4601	214.1203	208.6668	189.2664	187.9345	194.8687	196.3658	217.4153	229.1842	253.8916	(64)
										Total per year (kWh/year) = Sum(64)m =		2616.3507	(64)
12Total per year (kWh/year)												2616	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	135.4081	120.2467	128.6436	114.8476	112.5995	102.8080	102.2671	105.4563	105.6836	116.2681	121.7575	134.1236	(65)

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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	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	129.0428	142.8689	129.0428	133.3443	129.0428	133.3443	129.0428	129.0428	133.3443	129.0428	133.3443	129.0428	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	255.8419	258.4967	251.8066	237.5642	219.5856	202.6883	191.3999	188.7451	195.4352	209.6776	227.6562	244.5534 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837 (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)												
	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693 (71)
Water heating gains (Table 5)												
	182.0002	178.9385	172.9081	159.5106	151.3434	142.7889	137.4558	141.7424	146.7828	156.2744	169.1077	180.2736 (72)
Total internal gains												
	630.9358	644.3551	617.8085	594.4700	564.0228	542.8725	521.9495	523.5813	539.6132	559.0458	594.1591	617.9208 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.3500	10.6334	0.3300	0.8000	0.7700	10.4079	(74)
East	15.1000	19.6403	0.3300	0.8000	0.7700	54.2577	(76)

Solar gains	64.6656	126.0296	208.5948	309.2189	385.5583	398.1139	377.5791	319.5391	243.9320	149.6200	80.4925	53.2954	(83)
Total gains	695.6014	770.3847	826.4033	903.6889	949.5812	940.9864	899.5286	843.1203	783.5452	708.6658	674.6515	671.2163	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	177.1642	177.9610	178.7650	182.8964	183.7457	188.1134	188.1134	189.0119	186.3416	183.7457	182.0549	180.3950	
alpha	12.8109	12.8641	12.9177	13.1931	13.2497	13.5409	13.5409	13.6008	13.4228	13.2497	13.1370	13.0263	
util living area													
	0.9986	0.9938	0.9678	0.8190	0.6057	0.4111	0.2957	0.3282	0.5373	0.8770	0.9916	0.9990	(86)
MIT	20.7135	20.8001	20.9069	20.9908	20.9998	21.0000	21.0000	21.0000	21.0000	20.9832	20.8484	20.7046	(87)
Th 2	20.3908	20.3934	20.3960	20.4089	20.4114	20.4244	20.4244	20.4270	20.4192	20.4114	20.4063	20.4011	(88)
util rest of house													
	0.9979	0.9909	0.9551	0.7839	0.5676	0.3741	0.2570	0.2873	0.4921	0.8389	0.9872	0.9985	(89)
MIT 2	20.1337	20.2213	20.3241	20.4034	20.4113	20.4244	20.4244	20.4270	20.4192	20.4018	20.2806	20.1342	(90)
Living area fraction										fLA = Living area / (4) =		0.2152	(91)
MIT	20.2585	20.3459	20.4495	20.5299	20.5380	20.5483	20.5483	20.5503	20.5442	20.5270	20.4028	20.2570	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2585	20.3459	20.4495	20.5299	20.5380	20.5483	20.5483	20.5503	20.5442	20.5270	20.4028	20.2570	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9906	0.9564	0.7913	0.5758	0.3821	0.2653	0.2961	0.5018	0.8468	0.9871	0.9984	(94)
Useful gains	694.0232	763.1636	790.3551	715.0463	546.7422	359.5340	238.6475	249.6666	393.1943	600.1224	665.9682	670.1388	(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													
	1024.1993	986.8614	887.2510	723.0007	546.8973	359.5345	238.6475	249.6666	393.2131	614.2830	830.8277	1012.0636	(97)
Space heating kWh													
	245.6510	150.3250	72.0905	5.7272	0.1154	0.0000	0.0000	0.0000	0.0000	10.5355	118.6988	254.3920	(98a)
Space heating requirement - total per year (kWh/year)												857.5354	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	245.6510	150.3250	72.0905	5.7272	0.1154	0.0000	0.0000	0.0000	0.0000	10.5355	118.6988	254.3920	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												857.5354	
Space heating per m2											(98c) / (4) =	8.6012	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0500	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
245.6510 150.3250 72.0905 5.7272 0.1154 0.0000 0.0000 0.0000 0.0000 10.5355 118.6988 254.3920		(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25		
307a 179.9087 110.0942 52.7973 4.1945 0.0845 0.0000 0.0000 0.0000 0.0000 7.7159 86.9321 186.3104		
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25		
307b 142.5083 87.2073 41.8215 3.3225 0.0669 0.0000 0.0000 0.0000 0.0000 6.1119 68.8602 147.5792		

Space heating requirement												
	322.4169	197.3015	94.6188	7.5170	0.1514	0.0000	0.0000	0.0000	0.0000	13.8278	155.7922	333.8895 (307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement												
	256.4009	226.7761	241.4601	214.1203	208.6668	189.2664	187.9345	194.8687	196.3658	217.4153	229.1842	253.8916 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25												
310a	187.7816	166.0852	176.8394	156.8163	152.8223	138.6140	137.6385	142.7169	143.8134	159.2295	167.8488	185.9439
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25												
310b	148.7446	131.5585	140.0771	124.2165	121.0528	109.7982	109.0255	113.0482	113.9167	126.1281	132.9555	147.2889
Water heating fuel												
	336.5261	297.6437	316.9164	281.0329	273.8752	248.4121	246.6640	255.7651	257.7302	285.3576	300.8043	333.2327 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	16.6296	15.0203	16.6296	16.0932	16.6296	16.0932	16.6296	16.6296	16.0932	16.6296	16.0932	16.6296 (331)
Lighting	23.7070	19.0187	17.1242	12.5459	9.6908	7.9175	8.8403	11.4909	14.9256	19.5832	22.1192	24.3659 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												1125.5152 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												3433.9603 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												11.2552 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5875)												
mechanical ventilation fans (SFP = 0.5875)												195.8003 (330a)
Total electricity for the above, kWh/year												195.8003 (331)
Electricity for lighting (calculated in Appendix L)												191.3292 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												4946.6050 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	1258.5921	0.2100	264.3043	(363)
less credit emissions for electricity	-402.7495	0.3480	-140.1568	(364)
Water heating from Combined Heat and Power	3839.9796	0.2100	806.3957	(365)
less credit emissions for electricity	-1228.7935	0.3480	-427.6201	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2146.2068	0.2100	111.2570	(368)
Electrical energy for heat distribution (space & water)	11.2552	0.0000	6.6265	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			960.2531	(373)
Space and water heating			960.2531	(376)
Pumps, fans and electric keep-hot	195.8003	0.1387	27.1599	(378)
Energy for lighting	191.3292	0.1443	27.6147	(379)
Total CO2, kg/year			1015.0277	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.1800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	1258.5921	1.1300	1422.2091	(463)
less credit emissions for electricity	-402.7495	2.1490	-865.5086	(464)
Water heating from Combined Heat and Power	3839.9796	1.1300	4339.1770	(465)
less credit emissions for electricity	-1228.7935	2.1490	-2640.6772	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2146.2068	1.1300	598.6686	(468)
Electrical energy for heat distribution (space & water)	11.2552	0.0000	70.1034	(472)

Overall CO2 factor for heat network 1.0419 (486)
Total CO2 associated with community systems 4750.5173 (473)
Space and water heating 4750.5173 (476)
Pumps, fans and electric keep-hot 195.8003 1.5128 296.2067 (478)
Energy for lighting 191.3292 1.5338 293.4672 (479)
Total Primary energy kWh/year 5340.1912 (483)
Dwelling Primary energy Rate (DPER) 53.5600 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	99.7000 (1b)	x	2.7400 (2b)	=	273.1780 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	99.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		273.1780 (5)	

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1098	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3598	(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) =	0.3058	(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	0.3900	0.3823	0.3747	0.3364	0.3288	0.2906	0.2906	0.2829	0.3058	0.3288	0.3441	0.3594	(22b)
Effective ac	0.5760	0.5731	0.5702	0.5566	0.5540	0.5422	0.5422	0.5400	0.5468	0.5540	0.5592	0.5646	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			20.4500	1.1450	23.4160			(27)
External Wall 1	66.4998	20.4500	46.0498	0.1800	8.2890			(29a)
Total net area of external elements Aum(A, m2)			66.4998					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.7050			(33)
Party Wall 1			66.4700	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 420.5598 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total	
E2	Other lintels (including other steel lintels)	11.4100	0.0500	0.5705	
E3	Sill	7.9000	0.0500	0.3950	
E4	Jamb	24.9000	0.0500	1.2450	
E7	Party floor between dwellings (in blocks of flats)	48.5400	0.0700	3.3978	
E8	Balcony within a dwelling, wall insulation continuous	6.6000	0.0000	0.0000	
E16	Corner (normal)	5.4800	0.0900	0.4932	
E18	Party wall between dwellings	5.4800	0.0600	0.3288	
E17	Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1837 (36)
Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 37.8887 (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	51.9285	51.6624	51.4015	50.1761	49.9469	48.8796	48.8796	48.6820	49.2907	49.9469	50.4107	50.8955	(38)
Heat transfer coeff	89.8172	89.5511	89.2902	88.0648	87.8356	86.7683	86.7683	86.5707	87.1794	87.8356	88.2994	88.7842	(39)
Average = Sum(39)m / 12 =												88.0637	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9009	0.8982	0.8956	0.8833	0.8810	0.8703	0.8703	0.8683	0.8744	0.8810	0.8857	0.8905	(40)
HLP (average)												0.8833	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7367 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	70.1058	69.0522	67.5170	64.5796	62.4119	59.9944	58.6204	60.1440	61.8142	64.4097	67.4102	69.8372	(42a)
Hot water usage for baths	30.2710	29.8214	29.1883	28.0211	27.1470	26.1778	25.6543	26.2830	26.9674	28.0045	29.1958	30.1687	(42b)
Hot water usage for other uses	42.6569	41.1057	39.5545	38.0034	36.4522	34.9011	34.9011	36.4522	38.0034	39.5545	41.1057	42.6569	(42c)
Average daily hot water use (litres/day)												131.4801	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	143.0336	139.9794	136.2599	130.6040	126.0111	121.0733	119.1758	122.8792	126.7850	131.9688	137.7118	142.6627	(44)
Energy conte	226.5303	199.3287	209.4264	178.7904	169.6352	148.8738	144.1327	152.1501	156.3386	179.0804	196.1957	223.3753	(45)
Energy content (annual)											Total = Sum(45)m =	2183.8576	
Distribution loss (46)m = 0.15 x (45)m	33.9795	29.8993	31.4140	26.8186	25.4453	22.3311	21.6199	22.8225	23.4508	26.8621	29.4294	33.5063	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	271.1703	239.6487	254.0664	221.9904	214.2752	192.0738	188.7727	196.7901	199.5386	223.7204	239.3957	268.0153	(62)
WWHRS	-32.0494	-28.3448	-29.6810	-24.5771	-22.9049	-19.5999	-18.3718	-19.5366	-20.2788	-23.9065	-27.0832	-31.4559	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	239.1209	211.3040	224.3853	197.4133	191.3702	172.4739	170.4010	177.2535	179.2598	199.8139	212.3125	236.5594	(64)
											Total per year (kWh/year) = Sum(64)m =	2411.6677	(64)
12Total per year (kWh/year)												2412	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	111.0333	98.5328	105.3463	94.0078	92.1157	84.0605	83.6361	86.3019	86.5426	95.2562	99.7951	109.9843	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	129.6372	143.5269	129.6372	133.9585	129.6372	133.9585	129.6372	129.6372	133.9585	129.6372	133.9585	129.6372	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.8419	258.4967	251.8066	237.5642	219.5856	202.6883	191.3999	188.7451	195.4352	209.6776	227.6562	244.5534	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	(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)	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	(71)
Water heating gains (Table 5)	149.2383	146.6262	141.5944	130.5664	123.8114	116.7507	112.4142	115.9972	120.1980	128.0326	138.6043	147.8283	(72)
Total internal gains	598.7684	612.7008	587.0892	566.1400	537.0852	517.4485	497.5023	498.4305	513.6426	531.3984	564.2698	586.0700	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W

					W/m2	or Table 6b	or Table 6c		Table 6d				
North					5.3500	10.6334	0.6300	0.7000	0.7700			17.3859	(74)
East					15.1000	19.6403	0.6300	0.7000	0.7700			90.6350	(76)
Solar gains	108.0209	210.5267	348.4481	516.5362	644.0577	665.0312	630.7288	533.7755	407.4774	249.9334	134.4590	89.0276	(83)
Total gains	706.7893	823.2275	935.5373	1082.6761	1181.1429	1182.4797	1128.2310	1032.2059	921.1200	781.3318	698.7288	675.0976	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	129.6763	130.0617	130.4418	132.2568	132.6020	134.2330	134.2330	134.5395	133.6000	132.6020	131.9055	131.1851	
alpha	9.6451	9.6708	9.6961	9.8171	9.8401	9.9489	9.9489	9.9693	9.9067	9.8401	9.7937	9.7457	
util living area													
	0.9996	0.9981	0.9877	0.9002	0.6858	0.4695	0.3384	0.3858	0.6497	0.9619	0.9983	0.9998	(86)
MIT	20.4290	20.5536	20.7331	20.9344	20.9951	20.9999	21.0000	21.0000	20.9978	20.8832	20.6180	20.4115	(87)
Th 2	20.1668	20.1690	20.1713	20.1817	20.1837	20.1928	20.1928	20.1945	20.1893	20.1837	20.1797	20.1756	(88)
util rest of house													
	0.9994	0.9970	0.9812	0.8640	0.6284	0.4104	0.2763	0.3182	0.5753	0.9378	0.9971	0.9996	(89)
MIT 2	19.5030	19.6641	19.8915	20.1279	20.1809	20.1928	20.1928	20.1945	20.1884	20.0827	19.7558	19.4880	(90)
Living area fraction										fLA = Living area / (4) =		0.2152	(91)
MIT	19.7023	19.8556	20.0726	20.3015	20.3562	20.3665	20.3666	20.3679	20.3626	20.2550	19.9413	19.6868	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7023	19.8556	20.0726	20.3015	20.3562	20.3665	20.3666	20.3679	20.3626	20.2550	19.9413	19.6868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9992	0.9965	0.9802	0.8698	0.6407	0.4231	0.2897	0.3328	0.5914	0.9403	0.9966	0.9995	(94)
Useful gains	706.2573	820.3447	917.0310	941.6809	756.7385	500.2948	326.8173	343.4990	544.7177	734.7038	696.3765	674.7622	(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	1383.3936	1339.2865	1211.9024	1004.0709	760.3194	500.3503	326.8183	343.5029	545.9715	848.0521	1133.8825	1374.9854	(97)
Space heating kWh	503.7895	348.7289	219.3843	44.9208	2.6642	0.0000	0.0000	0.0000	0.0000	84.3311	315.0043	520.9661	(98a)
Space heating requirement - total per year (kWh/year)												2039.7892	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	503.7895	348.7289	219.3843	44.9208	2.6642	0.0000	0.0000	0.0000	0.0000	84.3311	315.0043	520.9661	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2039.7892	
Space heating per m2											(98c) / (4) =	20.4593	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
503.7895 348.7289 219.3843 44.9208 2.6642 0.0000 0.0000 0.0000 0.0000 84.3311 315.0043 520.9661		(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25		
307a 351.3932 243.2384 153.0206 31.3322 1.8583 0.0000 0.0000 0.0000 0.0000 58.8210 219.7155 363.3739		
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25		
307b 278.3437 192.6727 121.2098 24.8187 1.4720 0.0000 0.0000 0.0000 0.0000 46.5930 174.0399 287.8338		
Space heating requirement		
629.7368 435.9111 274.2304 56.1510 3.3302 0.0000 0.0000 0.0000 0.0000 105.4139 393.7554 651.2076		(307)
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 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(309)
Water heating		
Annual water heating requirement		
239.1209 211.3040 224.3853 197.4133 191.3702 172.4739 170.4010 177.2535 179.2598 199.8139 212.3125 236.5594		(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25		
310a 166.7868 147.3845 156.5088 137.6958 133.4807 120.3005 118.8547 123.6343 125.0337 139.3702 148.0880 165.0002		
Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25		
310b 132.1143 116.7454 123.9729 109.0709 105.7320 95.2918 94.1465 97.9326 99.0410 110.3972 117.3027 130.6991		
Water heating fuel		
298.9011 264.1300 280.4817 246.7667 239.2128 215.5923 213.0012 221.5669 224.0747 249.7674 265.3906 295.6992		(310)
Cooling System Energy Efficiency Ratio	0.0000	(314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(315)
Pumps and Fa 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(331)
Lighting 26.9361 21.6091 19.4566 14.2547 11.0108 8.9959 10.0444 13.0561 16.9586 22.2505 25.1319 27.6847		(332)
Electricity generated by PVs (Appendix M) (negative quantity)		

(333a)m	-14.4370	-22.0056	-34.1563	-41.5519	-47.6106	-45.4456	-44.8621	-40.9265	-34.5465	-26.4648	-16.4377	-12.2948	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-3.8106	-8.2913	-17.0196	-26.3940	-35.7554	-36.2752	-35.8811	-30.0073	-21.4921	-12.1525	-5.1767	-2.9952	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)

Annual totals kWh/year	
Space heating fuel - community heating	2549.7365 (307)
Space heating fuel - secondary	0.0000 (309)
Water heating fuel - community heating	3014.5846 (310)
Efficiency of water heater	0.0000 (311)
Electricity used for heat distribution	25.4974 (313)
Space cooling fuel	0.0000 (321)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (331)
Electricity for lighting (calculated in Appendix L)	217.3894 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-615.9903 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	5165.7202 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	2851.2084	0.2100	598.7538	(363)
less credit emissions for electricity	-912.3867	0.3480	-317.5106	(364)
Water heating from Combined Heat and Power	3371.0184	0.2100	707.9139	(365)
less credit emissions for electricity	-1078.7259	0.3480	-375.3966	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2619.2012	0.2100	252.0410	(368)
Electrical energy for heat distribution (space & water)	25.4974	0.0000	8.2743	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			1172.0670	(373)
Space and water heating			1172.0670	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	217.3894	0.1443	31.3760	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-380.7394	0.1330	-50.6435	
PV Unit electricity exported	-235.2509	0.1249	-29.3944	
Total			-80.0379	(380)
Total CO2, kg/year			1123.4051	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			11.2700	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	2851.2084	1.1300	3221.8654	(463)
less credit emissions for electricity	-912.3867	2.1490	-1960.7190	(464)
Water heating from Combined Heat and Power	3371.0184	1.1300	3809.2508	(465)
less credit emissions for electricity	-1078.7259	2.1490	-2318.1820	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2619.2012	1.1300	1356.2209	(468)
Electrical energy for heat distribution (space & water)	25.4974	0.0000	86.2550	(472)
Overall CO2 factor for heat network			1.0420	(486)
Total CO2 associated with community systems			5798.1677	(473)
Space and water heating			5798.1677	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	217.3894	1.5338	333.4391	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-380.7394	1.4915	-567.8750	
PV Unit electricity exported	-235.2509	0.4586	-107.8861	
Total			-675.7611	(480)
Total Primary energy kWh/year			5455.8456	(483)
Target Primary Energy Rate (TPER)			54.7200	(484)

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Property Reference	BH1+2 L03-6 03 x8_Copy	Issued on Date	12/09/2023
Assessment Reference	BH1+2 L03-6 03 x8_Copy	Prop Type Ref	
Property			

SAP Rating	88 B	DER	9.20	TER	10.63
Environmental	92 A	% DER < TER			13.45
CO_2 Emissions (t/year)	0.92	DFEE	26.92	TFEE	26.50
Compliance Check	See BREL	% DFEE < TFEE			-1.55
% DPER < TPER	5.12	DPER	48.98	TPER	51.62

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics
                                                                    Area          Storey height              Volume
                                                                    (m2)                (m)                  (m3)
Ground floor                                                  115.1000 (1b)    x      2.7400 (2b)    =     315.3740 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            115.1000                                        (4)
Dwelling volume                                                                (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     315.3740 (5)

2. Ventilation rate
                                                                                                        m3 per hour
Number of open chimneys                                                                          0 * 80 =       0.0000 (6a)
Number of open flues                                                                             0 * 20 =       0.0000 (6b)
Number of chimneys / flues attached to closed fire                                               0 * 10 =       0.0000 (6c)
Number of flues attached to solid fuel boiler                                                    0 * 20 =       0.0000 (6d)
Number of flues attached to other heater                                                         0 * 35 =       0.0000 (6e)
Number of blocked chimneys                                                                       0 * 20 =       0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =       0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                       Yes
Pressure Test Method                                                                                         Blower Door
Measured/design AP50                                                                                          3.0000 (17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)               0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                         72.8000 (23c)

Effective ac  0.2986    0.2954    0.2922    0.2762    0.2731    0.2571    0.2571    0.2539    0.2635    0.2731    0.2794    0.2858 (25)

3. Heat losses and heat loss parameter
Element                                          Gross       Openings        NetArea        U-value          A x U        K-value          A x K
                                                   m2            m2             m2          W/m2K            W/K          kJ/m2K           kJ/K
window (Uw = 1.30)                                                           17.7000         1.2357        21.8726                            (27)
front door                                                                    2.3000         1.0000         2.3000                            (26)
External Wall 1                                  66.4724       20.0000       46.4724         0.1400         6.5061        190.0000      8829.7560 (29a)
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Total net area of external elements Aum(A, m2)                  66.4724                                                  (31)
Fabric heat loss, W/K = Sum (A x U)                                  (26)...(30) + (32) =      30.6788                    (33)
Party Wall 1                                                    65.1000         0.0000         0.0000       180.0000   11718.0000 (32)
Party Floor 1                                                  115.1000                                     40.0000    4604.0000 (32d)
Party Ceiling 1                                                115.1000                                     30.0000    3453.0000 (32b)
Internal Wall 1                                                194.0000                                     75.0000   14550.0000 (32c)

Heat capacity Cm = Sum(A x k)                                                  (28)...(30) + (32) + (32a)...(32e) =   43154.7560 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                     374.9327 (35)
List of Thermal Bridges
        K1 Element                                                                          Length      Psi-value        Total
        E2 Other lintels (including other steel lintels)                                   11.0400         0.0300       0.3312
        E3 Sill                                                                             7.3400         0.0300       0.2202
        E4 Jamb                                                                            27.8800         0.0300       0.8364
        E7 Party floor between dwellings (in blocks of flats)                              48.5200         0.0700       3.3964
        E8 Balcony within a dwelling, wall insulation continuous                            3.4600         0.0000       0.0000
        E16 Corner (normal)                                                                 5.4800         0.0900       0.4932
        E18 Party wall between dwellings                                                   10.9600         0.0600       0.6576
        E17 Corner (inverted - internal area greater than external area)                    2.7400         0.0000       0.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                              5.9350 (36)
Point Thermal bridges                                                                                    (36a) =       0.0000
Total fabric heat loss                                                                  (33) + (36) + (36a) =      36.6138 (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         31.0724   30.7407   30.4090   28.7503   28.4185   26.7599   26.7599   26.4281   27.4233   28.4185   29.0820   29.7455 (38)
Heat transfer coeff
              67.6862   67.3544   67.0227   65.3640   65.0323   63.3736   63.3736   63.0419   64.0371   65.0323   65.6958   66.3592 (39)
Average = Sum(39)m / 12 =                                                                                               65.2811

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            0.5881    0.5852    0.5823    0.5679    0.5650    0.5506    0.5506    0.5477    0.5564    0.5650    0.5708    0.5765 (40)
HLP (average)                                                                                                           0.5672
Days in mont        31        28        31        30        31        30        31        31        30        31        30        31

4. Water heating energy requirements (kWh/year)
Assumed occupancy                                                                                                       2.8422 (42)
Hot water usage for mixer showers
              98.8274   97.3422   95.1780   91.0372   87.9813   84.5735   82.6365   84.7843   87.1388   90.7977   95.0275   98.4487 (42a)
Hot water usage for baths
              32.6648   32.1797   31.4966   30.2370   29.2938   28.2479   27.6830   28.3614   29.1000   30.2191   31.5047   32.5544 (42b)
Hot water usage for other uses
              46.0391   44.3649   42.6908   41.0166   39.3425   37.6683   37.6683   39.3425   41.0166   42.6908   44.3649   46.0391 (42c)
Average daily hot water use (litres/day)                                                                                163.2547 (43)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
             177.5313  173.8868  169.3653  162.2908  156.6176  150.4898  147.9879  152.4883  157.2554  163.7076  170.8971  177.0422 (44)
Energy conte  281.1661  247.6125  260.3082  222.1679  210.8374  185.0448  178.9786  188.8123  193.9117  222.1497  243.4742  277.2053 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =   2711.6688
Distribution loss  (46)m = 0.15 x (45)m
              42.1749   37.1419   39.0462   33.3252   31.6256   27.7567   26.8468   28.3218   29.0868   33.3225   36.5211   41.5808 (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)
Combi loss     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (61)
Total heat required for water heating calculated for each month
             336.4430  297.5400  315.5850  275.6616  266.1142  238.5385  234.2554  244.0891  247.4054  277.4265  296.9679  332.4821 (62)
WWHRS        -74.9664  -66.3009  -69.4264  -57.4878  -53.5766  -45.8459  -42.9732  -45.6977  -47.4339  -55.9193  -63.3498  -73.5781 (63a)
PV diverter    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63b)
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 (63c)
FGHRS          0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63d)
Output from w/h
             261.4766  231.2391  246.1586  218.1738  212.5376  192.6926  191.2822  198.3914  199.9715  221.5072  233.6181  258.9040 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =  2665.9526 (64)
12Total per year (kWh/year)                                                                                             2666 (64)
Electric shower(s)
               0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (64a)
                                                                  Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =    0.0000 (64a)
Heat gains from water heating, kWh/month
             137.7092  122.2731  130.7739  116.6658  114.3249  104.3223  103.7318  107.0015  107.2706  118.0862  123.7501  136.3922 (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        142.1108  142.1108  142.1108  142.1108  142.1108  142.1108  142.1108  142.1108  142.1108  142.1108  142.1108  142.1108 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
```

	144.1344	159.5773	144.1344	148.9388	144.1344	148.9388	144.1344	144.1344	148.9388	144.1344	148.9388	144.1344 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	278.6893	281.5813	274.2937	258.7794	239.1953	220.7890	208.4925	205.6006	212.8882	228.4025	247.9866	266.3928 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111 (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)												
	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887 (71)
Water heating gains (Table 5)												
	185.0930	181.9540	175.7714	162.0358	153.6625	144.8921	139.4245	143.8193	148.9869	158.7180	171.8752	183.3229 (72)
Total internal gains												
	673.5499	688.7459	659.8327	635.3873	602.6254	580.2533	557.6846	559.1875	576.4472	596.8881	634.4338	659.4833 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	17.7000	19.6403	0.3300	0.8000	0.7700	63.6001	(76)
Solar gains	63.6001	124.4153	204.8942	298.8260	366.2225	374.8939	356.9143	306.5841	238.3005	147.6292	79.3018	52.3016	(83)
Total gains	737.1500	813.1611	864.7269	934.2133	968.8479	955.1472	914.5989	865.7716	814.7476	744.5173	713.7357	711.7849	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	177.1031	177.9754	178.8563	183.3949	184.3304	189.1549	189.1549	190.1502	187.1951	184.3304	182.4688	180.6445	
alpha	12.8069	12.8650	12.9238	13.2263	13.2887	13.6103	13.6103	13.6767	13.4797	13.2887	13.1646	13.0430	
util living area													
	0.9985	0.9937	0.9697	0.8308	0.6238	0.4246	0.3049	0.3350	0.5423	0.8773	0.9912	0.9990	(86)
MIT	20.7159	20.8008	20.9039	20.9893	20.9997	21.0000	21.0000	21.0000	21.0000	20.9833	20.8514	20.7086	(87)
Th 2	20.4408	20.4434	20.4460	20.4590	20.4616	20.4747	20.4747	20.4773	20.4694	20.4616	20.4564	20.4512	(88)
util rest of house													
	0.9979	0.9911	0.9586	0.7989	0.5879	0.3898	0.2685	0.2969	0.5006	0.8427	0.9870	0.9985	(89)
MIT 2	20.1836	20.2696	20.3697	20.4524	20.4614	20.4747	20.4747	20.4773	20.4694	20.4516	20.3314	20.1858	(90)
Living area fraction											fLA = Living area / (4) =	0.3090	(91)
MIT	20.3481	20.4338	20.5348	20.6183	20.6278	20.6370	20.6370	20.6388	20.6334	20.6159	20.4921	20.3474	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3481	20.4338	20.5348	20.6183	20.6278	20.6370	20.6370	20.6388	20.6334	20.6159	20.4921	20.3474	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9910	0.9606	0.8085	0.5990	0.4006	0.2797	0.3087	0.5135	0.8531	0.9873	0.9984	(94)
Useful gains	735.4891	805.8636	830.6459	755.3479	580.3362	382.5866	255.8402	267.2234	418.3530	635.1644	704.6892	710.6299	(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													
	1086.2358	1046.2705	940.6484	765.9553	580.5944	382.5875	255.8402	267.2234	418.3786	651.3554	879.8064	1071.5279	(97)
Space heating kWh													
	260.9555	161.5535	81.8418	7.6374	0.1921	0.0000	0.0000	0.0000	0.0000	12.0461	126.0844	268.5081	(98a)
Space heating requirement - total per year (kWh/year)												918.8189	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	260.9555	161.5535	81.8418	7.6374	0.1921	0.0000	0.0000	0.0000	0.0000	12.0461	126.0844	268.5081	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												918.8189	
Space heating per m2											(98c) / (4) =	7.9828	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0500	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
260.9555 161.5535 81.8418 7.6374 0.1921 0.0000 0.0000 0.0000 0.0000 12.0461 126.0844 268.5081		(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25		
307a 191.1173 118.3177 59.9389 5.5934 0.1407 0.0000 0.0000 0.0000 0.0000 8.8223 92.3411 196.6486		
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25		
307b 151.3868 93.7212 47.4785 4.4306 0.1114 0.0000 0.0000 0.0000 0.0000 6.9883 73.1447 155.7683		

Space heating requirement

	342.5041	212.0389	107.4174	10.0240	0.2521	0.0000	0.0000	0.0000	0.0000	15.8106	165.4858	352.4169 (307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)

Water heating

Annual water heating requirement												
	261.4766	231.2391	246.1586	218.1738	212.5376	192.6926	191.2822	198.3914	199.9715	221.5072	233.6181	258.9040 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25												
310a	191.4989	169.3537	180.2804	159.7850	155.6572	141.1232	140.0903	145.2969	146.4541	162.2263	171.0960	189.6148
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25												
310b	151.6891	134.1476	142.8027	126.5681	123.2984	111.7858	110.9676	115.0918	116.0084	128.5018	135.5277	150.1967
Water heating fuel												
	343.1880	303.5013	323.0831	286.3531	278.9556	252.9090	251.0578	260.3888	262.4625	290.7281	306.6237	339.8115 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	22.8746	20.6609	22.8746	22.1367	22.8746	22.1367	22.8746	22.8746	22.1367	22.8746	22.1367	22.8746 (331)
Lighting	26.4795	21.2429	19.1269	14.0132	10.8242	8.8434	9.8742	12.8348	16.6712	21.8735	24.7060	27.2155 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												1205.9498 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												3499.0627 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												12.0595 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7000)												
mechanical ventilation fans (SFP = 0.7000)												269.3294 (330a)
Total electricity for the above, kWh/year												269.3294 (331)
Electricity for lighting (calculated in Appendix L)												213.7051 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												5188.0470 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	1348.5370	0.2100	283.1928	(363)
less credit emissions for electricity	-431.5318	0.3480	-150.1731	(364)
Water heating from Combined Heat and Power	3912.7796	0.2100	821.6837	(365)
less credit emissions for electricity	-1252.0895	0.3480	-435.7271	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2214.7130	0.2100	119.2079	(368)
Electrical energy for heat distribution (space & water)	12.0595	0.0000	6.8457	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			990.9117	(373)
Space and water heating			990.9117	(376)
Pumps, fans and electric keep-hot	269.3294	0.1387	37.3593	(378)
Energy for lighting	213.7051	0.1443	30.8443	(379)
Total CO2, kg/year			1059.1153	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.2000	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	1348.5370	1.1300	1523.8468	(463)
less credit emissions for electricity	-431.5318	2.1490	-927.3619	(464)
Water heating from Combined Heat and Power	3912.7796	1.1300	4421.4409	(465)
less credit emissions for electricity	-1252.0895	2.1490	-2690.7402	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2214.7130	1.1300	641.4523	(468)
Electrical energy for heat distribution (space & water)	12.0595	0.0000	72.3698	(472)

Overall CO2 factor for heat network 1.0419 (486)
Total CO2 associated with community systems 4902.1811 (473)
Space and water heating 4902.1811 (476)
Pumps, fans and electric keep-hot 269.3294 1.5128 407.4415 (478)
Energy for lighting 213.7051 1.5338 327.7881 (479)
Total Primary energy kWh/year 5637.4107 (483)
Dwelling Primary energy Rate (DPER) 48.9800 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		115.1000 (1b)	x	2.7400 (2b)	=	315.3740 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.1000					(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		315.3740 (5)	

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1268	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3768	(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) =	0.3203	(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	0.4084	0.4004	0.3924	0.3523	0.3443	0.3043	0.3043	0.2963	0.3203	0.3443	0.3603	0.3764	(22b)
Effective ac	0.5834	0.5802	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5649	0.5708	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.20)			17.7000	1.1450	20.2672			(27)
External Wall 1	66.4724	20.0000	46.4724	0.1800	8.3650			(29a)
Total net area of external elements Aum(A, m2)			66.4724					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.9322			(33)
Party Wall 1			65.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 384.9327 (35)
List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	11.0400	0.0500	0.5520	
E3 Sill	7.3400	0.0500	0.3670	
E4 Jamb	27.8800	0.0500	1.3940	
E7 Party floor between dwellings (in blocks of flats)	48.5200	0.0700	3.3964	
E8 Balcony within a dwelling, wall insulation continuous	3.4600	0.0000	0.0000	
E16 Corner (normal)	5.4800	0.0900	0.4932	
E18 Party wall between dwellings	10.9600	0.0600	0.6576	
E17 Corner (inverted – internal area greater than external area)	2.7400	-0.0900	-0.2466	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.6136 (36)

Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.5458 (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	60.7157	60.3786	60.0483	58.4967	58.2064	56.8550	56.8550	56.6048	57.3755	58.2064	58.7937	59.4076	(38)
Heat transfer coeff	98.2615	97.9245	97.5941	96.0425	95.7522	94.4008	94.4008	94.1506	94.9214	95.7522	96.3395	96.9535	(39)
Average = Sum(39)m / 12 =												96.0411	
HLP	0.8537	0.8508	0.8479	0.8344	0.8319	0.8202	0.8202	0.8180	0.8247	0.8319	0.8370	0.8423	(40)
HLP (average)												0.8344	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8422 (42)
Hot water usage for mixer showers

71.8744	70.7943	69.2203	66.2088	63.9864	61.5080	60.0993	61.6613	63.3736	66.0347	69.1109	71.5991	(42a)

Hot water usage for baths

31.0316	30.5707	29.9217	28.7251	27.8291	26.8355	26.2989	26.9433	27.6450	28.7082	29.9294	30.9267	(42b)

Hot water usage for other uses

43.7371	42.1467	40.5563	38.9658	37.3754	35.7849	35.7849	37.3754	38.9658	40.5563	42.1467	43.7371	(42c)

Average daily hot water use (litres/day) 134.7980 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	146.6432	143.5117	139.6983	133.8998	129.1909	124.1285	122.1831	125.9801	129.9845	135.2991	141.1870	146.2629	(44)
Energy conte	232.2469	204.3588	214.7111	183.3021	173.9158	152.6305	147.7699	155.9896	160.2839	183.5996	201.1468	229.0123	(45)
Energy content (annual)										Total = Sum(45)m =		2238.9673	
Distribution loss (46)m = 0.15 x (45)m	34.8370	30.6538	32.2067	27.4953	26.0874	22.8946	22.1655	23.3984	24.0426	27.5399	30.1720	34.3518	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	276.8869	244.6788	259.3511	226.5021	218.5558	195.8305	192.4099	200.6296	203.4839	228.2396	244.3468	273.6523	(62)
WWHRS	-32.8580	-29.0599	-30.4298	-25.1971	-23.4828	-20.0944	-18.8353	-20.0294	-20.7904	-24.5096	-27.7664	-32.2495	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	244.0289	215.6189	228.9213	201.3050	195.0730	175.7361	173.5746	180.6002	182.6934	203.7300	216.5803	241.4028	(64)
										Total per year (kWh/year) = Sum(64)m =		2459.2646	(64)
12Total per year (kWh/year)												2459	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	112.9341	100.2053	107.1035	95.5079	93.5390	85.3096	84.8455	87.5786	87.8544	96.7589	101.4413	111.8586	(65)

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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	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	147.8272	163.6658	147.8272	152.7548	147.8272	152.7548	147.8272	147.8272	152.7548	147.8272	152.7548	147.8272	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.6893	281.5813	274.2937	258.7794	239.1953	220.7890	208.4925	205.6006	212.8882	228.4025	247.9866	266.3928	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	(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)	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	(71)
Water heating gains (Table 5)	151.7932	149.1150	143.9563	132.6499	125.7245	118.4856	114.0396	117.7131	122.0200	130.0523	140.8907	150.3476	(72)
Total internal gains	643.9429	659.9953	631.7104	609.8173	578.3802	557.6627	535.9926	536.7741	553.2962	571.9152	607.2653	630.2008	(73)

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6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

			m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d		W	
East			17.7000	19.6403	0.6300	0.7000	0.7700		106.2411	(76)
Solar gains	106.2411	207.8301	342.2665	499.1753	611.7581	626.2432	596.2091	512.1348	398.0701	246.6079	132.4701	87.3675	(83)
Total gains	750.1840	867.8254	973.9769	1108.9926	1190.1382	1183.9059	1132.2017	1048.9089	951.3663	818.5231	739.7354	717.5683	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	125.2490	125.6801	126.1055	128.1428	128.5313	130.3713	130.3713	130.7178	129.6563	128.5313	127.7478	126.9388	
alpha	9.3499	9.3787	9.4070	9.5429	9.5688	9.6914	9.6914	9.7145	9.6438	9.5688	9.5165	9.4626	
util living area	0.9996	0.9983	0.9905	0.9249	0.7359	0.5099	0.3668	0.4129	0.6825	0.9688	0.9984	0.9998	(86)
MIT	20.3955	20.5180	20.6942	20.9072	20.9900	20.9997	21.0000	21.0000	20.9961	20.8620	20.5916	20.3807	(87)
Th 2	20.2070	20.2095	20.2120	20.2236	20.2258	20.2359	20.2359	20.2378	20.2320	20.2258	20.2214	20.2168	(88)
util rest of house	0.9995	0.9975	0.9858	0.8961	0.6800	0.4493	0.3032	0.3445	0.6097	0.9497	0.9975	0.9996	(89)
MIT 2	19.4990	19.6578	19.8826	20.1417	20.2196	20.2358	20.2359	20.2378	20.2303	20.0998	19.7622	19.4882	(90)
Living area fraction										fLA = Living area / (4) =		0.3090	(91)
MIT	19.7760	19.9236	20.1334	20.3783	20.4577	20.4719	20.4720	20.4733	20.4669	20.3353	20.0185	19.7640	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7760	19.9236	20.1334	20.3783	20.4577	20.4719	20.4720	20.4733	20.4669	20.3353	20.0185	19.7640	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9993	0.9971	0.9852	0.9024	0.6971	0.4680	0.3228	0.3656	0.6323	0.9530	0.9971	0.9995	(94)
Useful gains	749.6700	865.2946	959.5413	1000.7868	829.6584	554.1198	365.5179	383.4907	601.5628	780.0193	737.6030	717.2364	(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	1520.6976	1471.1783	1330.5401	1102.4025	838.5668	554.3085	365.5222	383.5046	604.3582	932.1773	1244.5645	1508.9874	(97)
Space heating kWh	573.6445	407.1538	276.0231	73.1633	6.6278	0.0000	0.0000	0.0000	0.0000	113.2055	365.0123	589.0628	(98a)
Space heating requirement - total per year (kWh/year)												2403.8932	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	573.6445	407.1538	276.0231	73.1633	6.6278	0.0000	0.0000	0.0000	0.0000	113.2055	365.0123	589.0628	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2403.8932	
Space heating per m2											(98c) / (4) =	20.8853	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
573.6445 407.1538 276.0231 73.1633 6.6278 0.0000 0.0000 0.0000 0.0000 113.2055 365.0123 589.0628		(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25		
307a 400.1171 283.9898 192.5261 51.0314 4.6229 0.0000 0.0000 0.0000 0.0000 78.9608 254.5961 410.8713		
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25		
307b 316.9386 224.9525 152.5028 40.4227 3.6619 0.0000 0.0000 0.0000 0.0000 62.5460 201.6693 325.4572		
Space heating requirement		
717.0557 508.9423 345.0289 91.4541 8.2848 0.0000 0.0000 0.0000 0.0000 141.5069 456.2654 736.3285		(307)
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 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(309)
Water heating		
Annual water heating requirement		
244.0289 215.6189 228.9213 201.3050 195.0730 175.7361 173.5746 180.6002 182.6934 203.7300 216.5803 241.4028		(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25		
310a 170.2102 150.3942 159.6726 140.4102 136.0634 122.5759 121.0683 125.9686 127.4287 142.1017 151.0648 168.3785		
Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25		
310b 134.8260 119.1294 126.4790 111.2210 107.7778 97.0942 95.9000 99.7816 100.9381 112.5608 119.6606 133.3751		
Water heating fuel		
305.0362 269.5236 286.1516 251.6312 243.8412 219.6701 216.9682 225.7502 228.3668 254.6625 270.7254 301.7535		(310)
Cooling System Energy Efficiency Ratio	0.0000	(314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(315)
Pumps and Fa 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(331)
Lighting 30.7156 24.6412 22.1866 16.2549 12.5557 10.2581 11.4538 14.8880 19.3381 25.3726 28.6583 31.5692		(332)
Electricity generated by PVs (Appendix M) (negative quantity)		

(333a)m	-16.5497	-25.1592	-38.9454	-47.2409	-54.0009	-51.4934	-50.8305	-46.4351	-39.2880	-30.2018	-18.8204	-14.1011	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-4.5164	-9.8175	-20.1352	-31.2002	-42.2420	-42.8502	-42.3845	-35.4554	-25.4066	-14.3804	-6.1326	-3.5507	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)

Annual totals kWh/year	
Space heating fuel - community heating	3004.8665 (307)
Space heating fuel - secondary	0.0000 (309)
Water heating fuel - community heating	3074.0807 (310)
Efficiency of water heater	0.0000 (311)
Electricity used for heat distribution	30.0487 (313)
Space cooling fuel	0.0000 (321)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	0.0000 (331)
Electricity for lighting (calculated in Appendix L)	247.8922 (332)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-711.1382 (333)
Wind generation	0.0000 (334)
Hydro-electric generation (Appendix N)	0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (335)
Appendix Q - special features	
Energy saved or generated	-0.0000 (336)
Energy used	0.0000 (337)
Total delivered energy for all uses	5615.7012 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	3360.1513	0.2100	705.6318	(363)
less credit emissions for electricity	-1075.2484	0.3480	-374.1864	(364)
Water heating from Combined Heat and Power	3437.5492	0.2100	721.8853	(365)
less credit emissions for electricity	-1100.0157	0.3480	-382.8055	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2861.4426	0.2100	297.0306	(368)
Electrical energy for heat distribution (space & water)	30.0487	0.0000	9.0652	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			1280.4933	(373)
Space and water heating			1280.4933	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	247.8922	0.1443	35.7785	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-433.0666	0.1331	-57.6284	
PV Unit electricity exported	-278.0717	0.1250	-34.7510	
Total			-92.3794	(380)
Total CO2, kg/year			1223.8924	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			10.6300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	3360.1513	1.1300	3796.9709	(463)
less credit emissions for electricity	-1075.2484	2.1490	-2310.7088	(464)
Water heating from Combined Heat and Power	3437.5492	1.1300	3884.4305	(465)
less credit emissions for electricity	-1100.0157	2.1490	-2363.9338	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2861.4426	1.1300	1598.3073	(468)
Electrical energy for heat distribution (space & water)	30.0487	0.0000	94.3294	(472)
Overall CO2 factor for heat network			1.0420	(486)
Total CO2 associated with community systems			6334.5185	(473)
Space and water heating			6334.5185	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	247.8922	1.5338	380.2254	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-433.0666	1.4917	-646.0137	
PV Unit electricity exported	-278.0717	0.4587	-127.5469	
Total			-773.5606	(480)
Total Primary energy kWh/year			5941.1833	(483)
Target Primary Energy Rate (TPER)			51.6200	(484)

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Property Reference	L01-6.04 SO x6_Copy_Copy	Issued on Date	12/09/2023
Assessment Reference	L00.04 SO_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	10.20	TER	12.48
Environmental	92 A	% DER < TER			18.27
CO_2 Emissions (t/year)	0.66	DFEE	27.44	TFEE	27.80
Compliance Check	See BREL	% DFEE < TFEE			1.28
% DPER < TPER	13.69	DPER	58.53	TPER	67.82

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		72.0000 (1b)	x	2.7400 (2b)	=	197.2800 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.0000					(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.2800	(5)

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2986	0.2954	0.2922	0.2762	0.2731	0.2571	0.2571	0.2539	0.2635	0.2731	0.2794	0.2858	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.30)			14.8000	1.2357	18.2890			(27)
External Wall 1	47.8404	14.8000	33.0404	0.1400	4.6257	190.0000	6277.6760	(29a)
Total net area of external elements Aum(A, m2)			47.8404					(31)

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Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	22.9146	(33)
Party Wall 1	58.2000	0.0000	0.0000	180.0000	10476.0000 (32)
Party Floor 1	72.0000			40.0000	2880.0000 (32d)
Party Ceiling 1	72.0000			30.0000	2160.0000 (32b)
Internal Wall 1	118.3600			75.0000	8877.0000 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =		30670.6760 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					425.9816 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	7.5700	0.0300	0.2271	
E3 Sill	5.9900	0.0300	0.1797	
E4 Jamb	17.1000	0.0300	0.5130	
E7 Party floor between dwellings (in blocks of flats)	34.9200	0.0700	2.4444	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	
E16 Corner (normal)	2.7400	0.0900	0.2466	
E8 Balcony within a dwelling, wall insulation continuous	5.8000	0.0000	0.0000	
E17 Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)			3.6930 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	26.6076 (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	19.4371	19.2296	19.0221	17.9845	17.7770	16.7395	16.7395	16.5319	17.1545	17.7770	18.1921	18.6071	(38)
Heat transfer coeff	46.0448	45.8373	45.6297	44.5922	44.3847	43.3471	43.3471	43.1396	43.7621	44.3847	44.7997	45.2147	(39)
Average = Sum(39)m / 12 =												44.5403	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6395	0.6366	0.6337	0.6193	0.6165	0.6020	0.6020	0.5992	0.6078	0.6165	0.6222	0.6280	(40)
HLP (average)												0.6186	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2937 (42)
Hot water usage for mixer showers	86.1812	84.8860	82.9988	79.3878	76.7230	73.7513	72.0621	73.9351	75.9883	79.1790	82.8675	85.8510 (42a)
Hot water usage for baths	27.0765	26.6744	26.1081	25.0640	24.2822	23.4152	22.9470	23.5093	24.1216	25.0492	26.1148	26.9849 (42b)
Hot water usage for other uses	38.1196	36.7335	35.3473	33.9611	32.5749	31.1888	31.1888	32.5749	33.9611	35.3473	36.7335	38.1196 (42c)
Average daily hot water use (litres/day)												139.2145 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.3773	148.2938	144.4541	138.4129	133.5801	128.3553	126.1979	130.0194	134.0709	139.5755	145.7158	150.9555	(44)
Energy conte	239.7446	211.1684	222.0206	189.4803	179.8245	157.8278	152.6254	160.9911	165.3229	189.4026	207.5988	236.3599	(45)
Energy content (annual)										Total = Sum(45)m =		2312.3670	
Distribution loss (46)m = 0.15 x (45)m	35.9617	31.6753	33.3031	28.4221	26.9737	23.6742	22.8938	24.1487	24.7984	28.4104	31.1398	35.4540	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8208	(55)
Total storage loss	25.4448	22.9824	25.4448	24.6240	25.4448	24.6240	25.4448	25.4448	24.6240	25.4448	24.6240	25.4448	(56)
If cylinder contains dedicated solar storage	25.4448	22.9824	25.4448	24.6240	25.4448	24.6240	25.4448	25.4448	24.6240	25.4448	24.6240	25.4448	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	288.4518	255.1620	270.7278	236.6163	228.5317	204.9638	201.3326	209.6983	212.4589	238.1098	254.7348	285.0671	(62)
WWHRS	-65.3735	-57.8168	-60.5425	-50.1315	-46.7208	-39.9793	-37.4742	-39.8501	-41.3641	-48.7638	-55.2434	-64.1628	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	223.0783	197.3452	210.1853	186.4848	181.8109	164.9845	163.8584	169.8482	171.0947	189.3460	199.4914	220.9042	(64)
										Total per year (kWh/year) = Sum(64)m =		2278.4321	(64)
12Total per year (kWh/year)												2278	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	118.6808	105.4084	112.7876	100.7110	98.7574	90.1866	89.7137	92.4953	92.6787	101.9421	106.7354	117.5554	(65)

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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	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	101.8450	112.7570	101.8450	105.2399	101.8450	105.2399	101.8450	101.8450	105.2399	101.8450	105.2399	101.8450	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	201.9192	204.0145	198.7344	187.4938	173.3045	159.9686	151.0594	148.9641	154.2442	165.4848	179.6741	193.0100	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	(71)
Water heating gains (Table 5)												
	159.5172	156.8577	151.5962	139.8764	132.7385	125.2591	120.5830	124.3217	128.7204	137.0190	148.2436	158.0046 (72)
Total internal gains												
	520.6867	531.0345	509.5810	490.0153	465.2933	447.8728	430.8926	432.5361	445.6097	461.7541	490.5628	510.2649 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.6500	10.6334	0.3300	0.8000	0.7700	22.6639	(74)
West	3.1500	19.6403	0.3300	0.8000	0.7700	11.3187	(80)

Solar gains	33.9826	65.4536	110.0617	171.3974	224.4236	237.1985	222.6836	180.8387	130.8975	77.8302	42.0719	28.2017	(83)
Total gains	554.6693	596.4881	619.6427	661.4127	689.7169	685.0714	653.5763	613.3747	576.5071	539.5842	532.6347	538.4665	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	185.0293	185.8670	186.7123	191.0567	191.9500	196.5445	196.5445	197.4900	194.6806	191.9500	190.1717	188.4261	
alpha	13.3353	13.3911	13.4475	13.7371	13.7967	14.1030	14.1030	14.1660	13.9787	13.7967	13.6781	13.5617	
util living area													
	0.9964	0.9884	0.9571	0.8061	0.5983	0.4050	0.2918	0.3235	0.5237	0.8395	0.9810	0.9972	(86)
MIT	20.7800	20.8489	20.9302	20.9935	20.9999	21.0000	21.0000	21.0000	21.0000	20.9912	20.8979	20.7732	(87)
Th 2	20.3946	20.3971	20.3997	20.4126	20.4152	20.4282	20.4282	20.4308	20.4230	20.4152	20.4100	20.4049	(88)
util rest of house													
	0.9946	0.9832	0.9411	0.7707	0.5608	0.3688	0.2539	0.2835	0.4800	0.7989	0.9718	0.9959	(89)
MIT 2	20.2019	20.2711	20.3477	20.4089	20.4152	20.4282	20.4282	20.4308	20.4230	20.4105	20.3299	20.2047	(90)
Living area fraction									fLA = Living area / (4) =			0.3778	(91)
MIT	20.4203	20.4894	20.5677	20.6298	20.6360	20.6442	20.6442	20.6458	20.6410	20.6299	20.5444	20.4195	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.4203	20.4894	20.5677	20.6298	20.6360	20.6442	20.6442	20.6458	20.6410	20.6299	20.5444	20.4195	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9947	0.9841	0.9460	0.7840	0.5749	0.3824	0.2682	0.2986	0.4965	0.8142	0.9742	0.9959	(94)
Useful gains	551.7436	587.0079	586.1776	518.5598	396.5416	261.9978	175.3038	183.1621	286.2379	439.3526	518.9097	536.2733	(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													
	742.2551	714.5743	641.9076	523.0557	396.6232	261.9980	175.3038	183.1621	286.2460	445.1743	602.3064	733.3596	(97)
Space heating kWh													
	141.7405	85.7246	41.4631	3.2370	0.0607	0.0000	0.0000	0.0000	0.0000	4.3314	60.0456	146.6322	(98a)
Space heating requirement - total per year (kWh/year)												483.2351	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	141.7405	85.7246	41.4631	3.2370	0.0607	0.0000	0.0000	0.0000	0.0000	4.3314	60.0456	146.6322	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												483.2351	
Space heating per m2											(98c) / (4) =	6.7116	(99)

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 %) 84.5000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	141.7405	85.7246	41.4631	3.2370	0.0607	0.0000	0.0000	0.0000	0.0000	4.3314	60.0456	146.6322	(98)
Space heating efficiency (main heating system 1)													
	84.5000	84.5000	84.5000	84.5000	84.5000	0.0000	0.0000	0.0000	0.0000	84.5000	84.5000	84.5000	(210)
Space heating fuel (main heating system)													
	167.7403	101.4492	49.0688	3.8308	0.0718	0.0000	0.0000	0.0000	0.0000	5.1259	71.0599	173.5292	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)

Space heating fuel (secondary)													
	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													
	223.0783	197.3452	210.1853	186.4848	181.8109	164.9845	163.8584	169.8482	171.0947	189.3460	199.4914	220.9042	(64)
Efficiency of water heater												89.5000	(216)
(217)m	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	(217)
Fuel for water heating, kWh/month													
	263.9980	233.5446	248.7401	220.6921	215.1609	195.2479	193.9153	201.0038	202.4790	224.0781	236.0845	261.4251	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	16.2581	14.6847	16.2581	15.7336	16.2581	15.7336	16.2581	16.2581	15.7336	16.2581	15.7336	16.2581	(231)
Lighting	18.7104	15.0102	13.5150	9.9017	7.6483	6.2488	6.9771	9.0691	11.7798	15.4557	17.4572	19.2304	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												571.8759	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												89.5000	
Water heating fuel used												2696.3693	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)													
mechanical ventilation fans (SFP = 0.6250)												150.4260	(230a)
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												191.4260	(231)
Electricity for lighting (calculated in Appendix L)												151.0036	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												3610.6748	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	571.8759	0.2100	120.0939	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2696.3693	0.2100	566.2376	(264)
Space and water heating			686.3315	(265)
Pumps, fans and electric keep-hot	191.4260	0.1387	26.5531	(267)
Energy for lighting	151.0036	0.1443	21.7945	(268)
Total CO2, kg/year			734.6791	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.2000	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	571.8759	1.1300	646.2198	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2696.3693	1.1300	3046.8973	(278)
Space and water heating			3693.1171	(279)
Pumps, fans and electric keep-hot	191.4260	1.5128	289.5893	(281)
Energy for lighting	151.0036	1.5338	231.6144	(282)
Total Primary energy kWh/year			4214.3207	(286)
Dwelling Primary energy Rate (DPER)			58.5300	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.0000 (1b)	x	2.7400 (2b)	=	197.2800 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.2800	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1521	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4021	(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) =	0.3418	(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	0.4357	0.4272	0.4187	0.3759	0.3674	0.3247	0.3247	0.3161	0.3418	0.3674	0.3845	0.4016	(22b)
Effective ac	0.5949	0.5912	0.5876	0.5707	0.5675	0.5527	0.5527	0.5500	0.5584	0.5675	0.5739	0.5806	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			14.8000	1.1450	16.9466			(27)
External Wall 1	47.8404	14.8000	33.0404	0.1800	5.9473			(29a)
Total net area of external elements Aum(A, m2)			47.8404					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		22.8938			(33)
Party Wall 1			58.2000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							435.9816	(35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total	
E2	Other lintels (including other steel lintels)	7.5700	0.0500	0.3785	
E3	Sill	5.9900	0.0500	0.2995	
E4	Jamb	17.1000	0.0500	0.8550	
E7	Party floor between dwellings (in blocks of flats)	34.9200	0.0700	2.4444	
E18	Party wall between dwellings	5.4800	0.0600	0.3288	
E16	Corner (normal)	2.7400	0.0900	0.2466	
E8	Balcony within a dwelling, wall insulation continuous	5.8000	0.0000	0.0000	
E17	Corner (inverted – internal area greater than external area)	2.7400	-0.0900	-0.2466	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.3062	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	27.2000	(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	38.7317	38.4917	38.2565	37.1515	36.9448	35.9824	35.9824	35.8042	36.3531	36.9448	37.3630	37.8002	(38)
Heat transfer coeff	65.9317	65.6918	65.4565	64.3516	64.1448	63.1825	63.1825	63.0043	63.5532	64.1448	64.5631	65.0003	(39)
Average = Sum(39)m / 12 =												64.3506	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9157	0.9124	0.9091	0.8938	0.8909	0.8775	0.8775	0.8751	0.8827	0.8909	0.8967	0.9028	(40)
HLP (average)												0.8938	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2937 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	62.6772	61.7353	60.3627	57.7366	55.7986	53.6373	52.4088	53.7710	55.2642	57.5847	60.2673	62.4371	(42a)
Hot water usage for baths	27.0765	26.6744	26.1081	25.0640	24.2822	23.4152	22.9470	23.5093	24.1216	25.0492	26.1148	26.9849	(42b)
Hot water usage for other uses	38.1196	36.7335	35.3473	33.9611	32.5749	31.1888	31.1888	32.5749	33.9611	35.3473	36.7335	38.1196	(42c)
Average daily hot water use (litres/day)												117.5446	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	127.8733	125.1431	121.8181	116.7617	112.6557	108.2413	106.5446	109.8552	113.3469	117.9812	123.1155	127.5416	(44)
Energy conte	202.5201	178.2021	187.2299	159.8409	151.6562	133.0953	128.8565	136.0237	139.7680	160.0994	175.4006	199.6994	(45)
Energy content (annual)											Total = Sum(45)m =	1952.3920	
Distribution loss (46)m = 0.15 x (45)m	30.3780	26.7303	28.0845	23.9761	22.7484	19.9643	19.3285	20.4036	20.9652	24.0149	26.3101	29.9549	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	251.7627	222.6793	236.4725	207.4951	200.8989	180.7495	178.0991	185.2664	187.4222	209.3420	223.0548	248.9420	(62)
WWHRS	-28.6534	-25.3413	-26.5360	-21.9728	-20.4779	-17.5231	-16.4251	-17.4664	-18.1300	-21.3733	-24.2134	-28.1228	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	223.1093	197.3380	209.9366	185.5223	180.4210	163.2265	161.6740	167.8000	169.2922	187.9687	198.8415	220.8192	(64)
										Total per year (kWh/year) = Sum(64)m =		2265.9493	(64)
12Total per year (kWh/year)												2266	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	106.7321	94.8340	101.6481	91.2705	89.8198	82.3776	82.2389	84.6220	84.5962	92.6272	96.4441	105.7942	(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	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	102.2951	113.2553	102.2951	105.7050	102.2951	105.7050	102.2951	102.2951	105.7050	102.2951	105.7050	102.2951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	201.9192	204.0145	198.7344	187.4938	173.3045	159.9686	151.0594	148.9641	154.2442	165.4848	179.6741	193.0100	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	(71)
Water heating gains (Table 5)	143.4571	141.1220	136.6237	126.7645	120.7256	114.4133	110.5362	113.7393	117.4948	124.4989	133.9501	142.1965	(72)
Total internal gains	508.0767	518.7971	498.0586	480.3686	456.7305	437.4921	421.2960	422.4038	434.8492	452.6841	479.7344	497.9068	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.6500	10.6334	0.6300	0.7000	0.7700	37.8590	(74)
West	3.1500	19.6403	0.6300	0.7000	0.7700	18.9073	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	56.7663	109.3373	183.8531	286.3115	374.8894	396.2294	371.9829	302.0828	218.6582	130.0117	70.2792	47.1096	(83)
Total gains	564.8430	628.1344	681.9117	766.6801	831.6199	833.7215	793.2788	724.4866	653.5074	582.6958	550.0136	545.0165	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	132.2524	132.7356	133.2126	135.4999	135.9366	138.0071	138.0071	138.3975	137.2022	135.9366	135.0561	134.1476

alpha	9.8168	9.8490	9.8808	10.0333	10.0624	10.2005	10.2005	10.2265	10.1468	10.0624	10.0037	9.9432
util living area												
	0.9993	0.9976	0.9890	0.9162	0.7100	0.4849	0.3504	0.4000	0.6671	0.9582	0.9971	0.9995 (86)
MIT	20.4830	20.5846	20.7351	20.9264	20.9941	20.9999	21.0000	21.0000	20.9975	20.8949	20.6630	20.4720 (87)
Th 2	20.1542	20.1570	20.1598	20.1728	20.1752	20.1866	20.1866	20.1888	20.1822	20.1752	20.1703	20.1651 (88)
util rest of house												
	0.9989	0.9962	0.9828	0.8822	0.6505	0.4233	0.2857	0.3295	0.5903	0.9316	0.9951	0.9992 (89)
MIT 2	19.5595	19.6914	19.8827	20.1120	20.1720	20.1866	20.1866	20.1887	20.1813	20.0868	19.8029	19.5546 (90)
Living area fraction									fLA = Living area / (4) =			0.3778 (91)
MIT	19.9084	20.0288	20.2047	20.4197	20.4826	20.4938	20.4939	20.4952	20.4896	20.3921	20.1278	19.9011 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9084	20.0288	20.2047	20.4197	20.4826	20.4938	20.4939	20.4952	20.4896	20.3921	20.1278	19.9011 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9987	0.9960	0.9832	0.8933	0.6730	0.4466	0.3101	0.3561	0.6195	0.9398	0.9950	0.9991	(94)
Useful gains	564.1361	625.5974	670.4449	684.8796	559.6967	372.3318	246.0255	258.0118	404.8458	547.5963	547.2713	544.5195	(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													
	1029.0870	993.8388	897.0630	741.3085	563.3554	372.3872	246.0266	258.0161	406.0825	628.1106	841.1175	1020.5787	(97)
Space heating kWh													
	345.9235	247.4582	168.6039	40.6288	2.7220	0.0000	0.0000	0.0000	0.0000	59.9027	211.5693	354.1880	(98a)
Space heating requirement - total per year (kWh/year)												1430.9965	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	345.9235	247.4582	168.6039	40.6288	2.7220	0.0000	0.0000	0.0000	0.0000	59.9027	211.5693	354.1880	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1430.9965	
Space heating per m2											(98c) / (4) =	19.8750	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	345.9235	247.4582	168.6039	40.6288	2.7220	0.0000	0.0000	0.0000	0.0000	59.9027	211.5693	354.1880	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	374.7817	268.1021	182.6695	44.0182	2.9491	0.0000	0.0000	0.0000	0.0000	64.9000	229.2192	383.7357	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	223.1093	197.3380	209.9366	185.5223	180.4210	163.2265	161.6740	167.8000	169.2922	187.9687	198.8415	220.8192	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.0395	84.5685	83.5727	81.2800	79.9204	79.8000	79.8000	79.8000	79.8000	81.8037	84.1992	85.1136	(217)
Fuel for water heating, kWh/month													
	262.3595	233.3471	251.2024	228.2510	225.7509	204.5444	202.5991	210.2757	212.1456	229.7804	236.1561	259.4406	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	21.2549	17.0515	15.3530	11.2482	8.6885	7.0986	7.9259	10.3024	13.3818	17.5576	19.8313	21.8456	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-7.9527	-12.3348	-19.4826	-24.1407	-28.0746	-26.9689	-26.6424	-24.1143	-20.0659	-15.0285	-9.1322	-6.7512	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-1.6311	-3.5775	-7.3956	-11.5453	-15.7102	-15.9518	-15.7648	-13.1410	-9.3663	-5.2538	-2.2200	-1.2793	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1550.3754	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												2755.8526	(219)

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Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	171.5393 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-323.5255 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4240.2418 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1550.3754	0.2100	325.5788	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2755.8526	0.2100	578.7291	(264)
Space and water heating			904.3079	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	171.5393	0.1443	24.7584	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-220.6887	0.1326	-29.2744	
PV Unit electricity exported	-102.8368	0.1248	-12.8326	
Total			-42.1069	(269)
Total CO2, kg/year			898.8886	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.4800	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1550.3754	1.1300	1751.9242	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2755.8526	1.1300	3114.1135	(278)
Space and water heating			4866.0377	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	171.5393	1.5338	263.1127	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-220.6887	1.4901	-328.8571	
PV Unit electricity exported	-102.8368	0.4580	-47.0988	
Total			-375.9559	(283)
Total Primary energy kWh/year			4883.2953	(286)
Target Primary Energy Rate (TPER)			67.8200	(287)

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Property Reference	L02.02 x1_Copy_Copy_Copy	Issued on Date	12/09/2023
Assessment Reference	L02.02 x1_Copy_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	9.11	TER	10.15
Environmental	91 B	% DER < TER			10.25
CO_2 Emissions (t/year)	0.97	DFEE	23.27	TFEE	30.66
Compliance Check	See BREL	% DFEE < TFEE			24.11
% DPER < TPER	1.59	DPER	53.03	TPER	53.88

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics
                                                                  Area          Storey height              Volume
                                                                  (m2)                (m)                   (m3)
Ground floor                                                 61.9000 (1b)    x      2.5000 (2b)    =    154.7500 (1b) -
First floor                                                  61.8000 (1c)    x      2.9500 (2c)    =    182.3100 (1c) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            123.7000                                        (4)
Dwelling volume                                                                (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    337.0600 (5)

2. Ventilation rate
                                                                                                    m3 per hour
Number of open chimneys                                                                  0 * 80 =       0.0000 (6a)
Number of open flues                                                                     0 * 20 =       0.0000 (6b)
Number of chimneys / flues attached to closed fire                                       0 * 10 =       0.0000 (6c)
Number of flues attached to solid fuel boiler                                            0 * 20 =       0.0000 (6d)
Number of flues attached to other heater                                                 0 * 35 =       0.0000 (6e)
Number of blocked chimneys                                                               0 * 20 =       0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =    0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                      Yes
Pressure Test Method                                                                                         Blower Door
Measured/design AP50                                                                                            3.0000 (17)
Infiltration rate                                                                                               0.1500 (18)
Number of sides sheltered                                                                                          1 (19)

Shelter factor                                                                  (20) =  1  -  [0.075 x (19)]  =      0.9250 (20)
Infiltration rate adjusted to include shelter factor                                      (21) = (18) x (20)  =      0.1388 (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
                0.1769    0.1734    0.1700    0.1526    0.1492    0.1318    0.1318    0.1283    0.1388    0.1492    0.1561    0.1630 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation                                                                                          0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)            0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                      43.0000 (23c)

Effective ac    0.4619    0.4584    0.4550    0.4376    0.4342    0.4168    0.4168    0.4133    0.4238    0.4342    0.4411    0.4480 (25)

3. Heat losses and heat loss parameter
Element                                          Gross      Openings      NetArea      U-value       A x U       K-value       A x K
                                                   m2          m2           m2         W/m2K         W/K         kJ/m2K        kJ/K
window (Uw = 0.80)                                                          23.5000      0.7752      18.2171                         (27)
External Wall 1                                127.4340     23.5000      103.9340      0.1300      13.5114      190.0000    19747.4600 (29a)
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External Roof 1                                  8.0000      8.0000      0.1000      0.8000      9.0000     72.0000 (30)
Total net area of external elements Aum(A, m2)                135.4340                                               (31)
Fabric heat loss, W/K = Sum (A x U)                 (26)...(30) + (32) =     32.5285                                  (33)
Party Wall 1                                                   67.3000      0.0000      0.0000    180.0000  12114.0000 (32)
Party Floor 1                                                  61.9000                           40.0000   2476.0000 (32d)
Party Ceiling 1                                                53.8000                           30.0000   1614.0000 (32b)
Internal Wall 1                                               221.5800                            9.0000   1994.2200 (32c)
Internal Floor 1                                               61.8000                           18.0000   1112.4000 (32d)

Heat capacity Cm = Sum(A x k)                                                (28)...(30) + (32) + (32a)...(32e) =  39130.0800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                 316.3305 (35)
List of Thermal Bridges
        K1 Element                                                                    Length      Psi-value         Total
        E2 Other lintels (including other steel lintels)                              17.1500         0.0500         0.8575
        E3 Sill                                                                       15.5700         0.0500         0.7785
        E4 Jamb                                                                       33.5200         0.0500         1.6760
        E6 Intermediate floor within a dwelling                                       23.5000         0.0000         0.0000
        E16 Corner (normal)                                                           16.2000         0.0900         1.4580
        E18 Party wall between dwellings                                              10.8000         0.0600         0.6480
        E7 Party floor between dwellings (in blocks of flats)                         36.1000         0.0700         2.5270
        E24 Eaves (insulation at ceiling level - inverted)                             4.1000         0.1500         0.6150
        E14 Flat roof                                                                  8.1000         0.0800         0.6480
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                          9.2080 (36)
Point Thermal bridges                                                                                  (36a) =      0.0000
Total fabric heat loss                                                                  (33) + (36) + (36a) =     41.7365 (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           51.3777   50.9919   50.6061   48.6769   48.2911   46.3620   46.3620   45.9761   47.1336   48.2911   49.0628   49.8344 (38)
Heat transfer coeff
                93.1142   92.7284   92.3426   90.4134   90.0276   88.0984   88.0984   87.7126   88.8701   90.0276   90.7992   91.5709 (39)
Average = Sum(39)m / 12 =                                                                                          90.3170

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP             0.7527    0.7496    0.7465    0.7309    0.7278    0.7122    0.7122    0.7091    0.7184    0.7278    0.7340    0.7403 (40)
HLP (average)                                                                                                      0.7301
Days in mont         31        28        31        30        31        30        31        31        30        31        30        31

4. Water heating energy requirements (kWh/year)
Assumed occupancy                                                                                                  2.8765 (42)
Hot water usage for mixer showers
                99.6188   98.1217   95.9402   91.7662   88.6859   85.2508   83.2983   85.4634   87.8366   91.5249   95.7885   99.2371 (42a)
Hot water usage for baths
                31.2791   30.8146   30.1604   28.9542   28.0511   27.0496   26.5087   27.1583   27.8655   28.9372   30.1682   31.1734 (42b)
Hot water usage for other uses
                44.0887   42.4855   40.8823   39.2790   37.6758   36.0726   36.0726   37.6758   39.2790   40.8823   42.4855   44.0887 (42c)
Average daily hot water use (litres/day)                                                                           160.9265 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
                174.9867  171.4218  166.9829  159.9995  154.4128  148.3730  145.8796  150.2974  154.9812  161.3443  168.4422  174.4992 (44)
Energy conte    277.1361  244.1024  256.6465  219.0313  207.8694  182.4420  176.4287  186.0996  191.1073  218.9427  239.9767  273.2236 (45)
Energy content (annual)                                                                  Total = Sum(45)m =   2673.0063
Distribution loss  (46)m = 0.15 x (45)m
                41.5704   36.6154   38.4970   32.8547   31.1804   27.3663   26.4643   27.9149   28.6661   32.8414   35.9965   40.9835 (46)
Water storage loss:
Store volume                                                                                                       180.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                        1.5500 (48)
  Temperature factor from Table 2b                                                                                 0.5400 (49)
Enter (49) or (54) in (55)                                                                                         0.8370 (55)
Total storage loss
                25.9470   23.4360   25.9470   25.1100   25.9470   25.1100   25.9470   25.9470   25.1100   25.9470   25.1100   25.9470 (56)
If cylinder contains dedicated solar storage
                25.9470   23.4360   25.9470   25.1100   25.9470   25.1100   25.9470   25.9470   25.1100   25.9470   25.1100   25.9470 (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)
Combi loss       0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (61)
Total heat required for water heating calculated for each month
                326.3455  288.5496  305.8559  266.6533  257.0788  230.0640  225.6381  235.3090  238.7293  268.1521  287.5987  322.4330 (62)
WWHRS          -75.5667  -66.8318  -69.9824  -57.9482  -54.0057  -46.2130  -43.3174  -46.0637  -47.8138  -56.3672  -63.8572  -74.1673 (63a)
PV diverter      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63b)
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 (63c)
FGHRS            0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63d)
Output from w/h
                250.7788  221.7177  235.8734  208.7051  203.0731  183.8509  182.3208  189.2453  190.9155  211.7849  223.7416  248.2657 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =  2550.2728 (64)
12Total per year (kWh/year)                                                                                        2550 (64)
Electric shower(s)
                  0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (64a)
                                                                  Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =     0.0000 (64a)
Heat gains from water heating, kWh/month
                131.5153  116.7218  124.7025  110.9255  108.4841   98.7596   98.0301  101.2456  101.6408  112.1660  117.8899  130.2144 (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           143.8273  143.8273  143.8273  143.8273  143.8273  143.8273  143.8273  143.8273  143.8273  143.8273  143.8273  143.8273 (66)
```

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	148.1891	164.0665	148.1891	153.1287	148.1891	153.1287	148.1891	148.1891	153.1287	148.1891	153.1287	148.1891 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	289.9549	292.9638	285.3816	269.2401	248.8644	229.7141	216.9205	213.9117	221.4939	237.6353	258.0111	277.1614 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619 (71)
Water heating gains (Table 5)												
	176.7678	173.6932	167.6108	154.0632	145.8119	137.1660	131.7608	136.0828	141.1678	150.7607	163.7359	175.0193 (72)
Total internal gains												
	684.0601	699.8716	670.3298	645.5803	612.0137	586.1571	563.0187	564.3318	581.9385	605.7333	644.0239	669.5180 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3000	10.6334	0.5000	0.8000	0.7700	12.6746	(74)
Southeast	5.7500	36.7938	0.5000	0.8000	0.7700	58.6457	(77)
South	6.3000	46.7521	0.5000	0.8000	0.7700	81.6459	(78)
West	7.1500	19.6403	0.5000	0.8000	0.7700	38.9266	(80)

Solar gains	191.8928	333.9808	473.5751	610.8722	703.5031	706.1699	677.6496	607.8365	521.2642	373.8195	231.1949	163.3156 (83)
Total gains	875.9529	1033.8524	1143.9049	1256.4525	1315.5167	1292.3270	1240.6682	1172.1683	1103.2028	979.5528	875.2188	832.8336 (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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	116.7326	117.2183	117.7081	120.2196	120.7348	123.3786	123.3786	123.9214	122.3073	120.7348	119.7088	118.7000	
alpha	8.7822	8.8146	8.8472	9.0146	9.0490	9.2252	9.2252	9.2614	9.1538	9.0490	8.9806	8.9133	
util living area	0.9972	0.9876	0.9541	0.8276	0.6325	0.4362	0.3124	0.3442	0.5547	0.8790	0.9882	0.9981	(86)
MIT	20.4807	20.6403	20.8112	20.9586	20.9961	20.9999	21.0000	21.0000	20.9990	20.9424	20.6965	20.4601	(87)
Th 2	20.2945	20.2972	20.2999	20.3136	20.3164	20.3301	20.3301	20.3328	20.3246	20.3164	20.3109	20.3054	(88)
util rest of house	0.9961	0.9833	0.9399	0.7924	0.5876	0.3906	0.2649	0.2943	0.5010	0.8425	0.9833	0.9973	(89)
MIT 2	19.8245	19.9837	20.1480	20.2858	20.3143	20.3300	20.3301	20.3328	20.3242	20.2785	20.0519	19.8136	(90)
Living area fraction										fLA = Living area / (4) =		0.2211	(91)
MIT	19.9696	20.1289	20.2946	20.4346	20.4650	20.4781	20.4782	20.4803	20.4734	20.4253	20.1944	19.9566	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9696	20.1289	20.2946	20.4346	20.4650	20.4781	20.4782	20.4803	20.4734	20.4253	20.1944	19.9566	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9820	0.9397	0.7989	0.5975	0.4007	0.2754	0.3053	0.5129	0.8488	0.9823	0.9968	(94)
Useful gains	871.9622	1015.2501	1074.9626	1003.7726	785.9805	517.7875	341.6611	357.8924	565.7878	831.4015	859.7467	830.1955	(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	1459.0645	1412.1518	1273.8308	1042.8813	789.0947	517.8547	341.6627	357.8966	566.4050	884.5466	1188.9620	1442.8415	(97)
Space heating kWh	436.8041	266.7180	147.9580	28.1583	2.3170	0.0000	0.0000	0.0000	0.0000	39.5400	237.0350	455.8087	(98a)
Space heating requirement - total per year (kWh/year)												1614.3391	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	436.8041	266.7180	147.9580	28.1583	2.3170	0.0000	0.0000	0.0000	0.0000	39.5400	237.0350	455.8087	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1614.3391	
Space heating per m2										(98c) / (4) =		13.0504	(99)

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 %)	84.5000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	436.8041	266.7180	147.9580	28.1583	2.3170	0.0000	0.0000	0.0000	0.0000	39.5400	237.0350	455.8087	(98)
Space heating efficiency (main heating system 1)	84.5000	84.5000	84.5000	84.5000	84.5000	0.0000	0.0000	0.0000	0.0000	84.5000	84.5000	84.5000	(210)

Space heating fuel (main heating system)												
	516.9279	315.6426	175.0982	33.3235	2.7420	0.0000	0.0000	0.0000	0.0000	46.7929	280.5148	539.4185 (211)
Space heating efficiency (main heating system 2)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)												
	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												
	250.7788	221.7177	235.8734	208.7051	203.0731	183.8509	182.3208	189.2453	190.9155	211.7849	223.7416	248.2657 (64)
Efficiency of water heater												89.5000 (216)
(217)m	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000 (217)
Fuel for water heating, kWh/month												
	296.7796	262.3879	279.1401	246.9883	240.3232	217.5751	215.7642	223.9590	225.9355	250.6330	264.7829	293.8055 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	36.6609	33.1131	36.6609	35.4783	36.6609	35.4783	36.6609	36.6609	35.4783	36.6609	35.4783	36.6609 (231)
Lighting	27.2245	21.8405	19.6649	14.4074	11.1287	9.0922	10.1519	13.1959	17.1401	22.4888	25.4010	27.9811 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1910.4604 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												89.5000
Water heating fuel used												3018.0743 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500)												
mechanical ventilation fans (SFP = 0.9500)												390.6525 (230a)
central heating pump												41.0000 (230c)
Total electricity for the above, kWh/year												431.6525 (231)
Electricity for lighting (calculated in Appendix L)												219.7170 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												5579.9043 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1910.4604	0.2100	401.1967	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3018.0743	0.2100	633.7956	(264)
Space and water heating			1034.9923	(265)
Pumps, fans and electric keep-hot	431.6525	0.1387	59.8755	(267)
Energy for lighting	219.7170	0.1443	31.7120	(268)
Total CO2, kg/year			1126.5798	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.1100	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1910.4604	1.1300	2158.8203	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3018.0743	1.1300	3410.4240	(278)
Space and water heating			5569.2443	(279)
Pumps, fans and electric keep-hot	431.6525	1.5128	653.0040	(281)
Energy for lighting	219.7170	1.5338	337.0093	(282)
Total Primary energy kWh/year			6559.2575	(286)
Dwelling Primary energy Rate (DPER)			53.0300	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.9000 (1b)	x	2.5000 (2b)	=	154.7500 (1b)	-
First floor	61.8000 (1c)	x	2.9500 (2c)	=	182.3100 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	123.7000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	337.0600	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1187	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3687	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3410	(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	0.4348	0.4263	0.4178	0.3751	0.3666	0.3240	0.3240	0.3154	0.3410	0.3666	0.3837	0.4007	(22b)
Effective ac	0.5945	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5581	0.5672	0.5736	0.5803	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			23.5000	1.1450	26.9084			(27)
External Wall 1	127.4340	23.5000	103.9340	0.1800	18.7081			(29a)
External Roof 1	8.0000		8.0000	0.1100	0.8800			(30)
Total net area of external elements Aum(A, m2)			135.4340					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.4965			(33)
Party Wall 1			67.3000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 320.6797 (35)

List of Thermal Bridges

		Length	Psi-value	Total	
K1	Element				
E2	Other lintels (including other steel lintels)	17.1500	0.0500	0.8575	
E3	Sill	15.5700	0.0500	0.7785	
E4	Jamb	33.5200	0.0500	1.6760	
E6	Intermediate floor within a dwelling	23.5000	0.0000	0.0000	
E16	Corner (normal)	16.2000	0.0900	1.4580	
E18	Party wall between dwellings	10.8000	0.0600	0.6480	
E7	Party floor between dwellings (in blocks of flats)	36.1000	0.0700	2.5270	
E24	Eaves (insulation at ceiling level - inverted)	4.1000	0.2400	0.9840	
E14	Flat roof	8.1000	0.0800	0.6480	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5770 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 56.0735 (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	66.1291	65.7209	65.3207	63.4410	63.0893	61.4521	61.4521	61.1489	62.0827	63.0893	63.8007	64.5445	(38)
Heat transfer coeff	122.2027	121.7944	121.3942	119.5145	119.1628	117.5256	117.5256	117.2224	118.1562	119.1628	119.8743	120.6180	(39)

Average = Sum(39)m / 12 = 119.5128

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9879	0.9846	0.9814	0.9662	0.9633	0.9501	0.9501	0.9476	0.9552	0.9633	0.9691	0.9751	(40)
HLP (average)												0.9662	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8765 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.4501	71.3613	69.7747	66.7391	64.4989	62.0006	60.5806	62.1552	63.8812	66.5636	69.6644	72.1725	(42a)

Hot water usage for baths

31.2791	30.8146	30.1604	28.9542	28.0511	27.0496	26.5087	27.1583	27.8655	28.9372	30.1682	31.1734	(42b)

Hot water usage for other uses

44.0887	42.4855	40.8823	39.2790	37.6758	36.0726	36.0726	37.6758	39.2790	40.8823	42.4855	44.0887	(42c)

Average daily hot water use (litres/day) 135.8778 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.8179	144.6613	140.8174	134.9724	130.2258	125.1228	123.1619	126.9892	131.0258	136.3830	142.3180	147.4346	(44)
Energy conte	234.1074	205.9958	216.4311	184.7704	175.3089	153.8531	148.9536	157.2392	161.5679	185.0704	202.7581	230.8469	(45)
Energy content (annual)											Total = Sum(45)m =	2256.9027	
Distribution loss (46)m = 0.15 x (45)m	35.1161	30.8994	32.4647	27.7156	26.2963	23.0780	22.3430	23.5859	24.2352	27.7606	30.4137	34.6270	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	283.3501	250.4731	265.6737	232.4246	224.5516	201.5073	198.1963	206.4819	209.2221	234.3131	250.4123	280.0895	(62)
WWHRS	-33.1211	-29.2926	-30.6735	-25.3989	-23.6709	-20.2553	-18.9861	-20.1899	-20.9569	-24.7059	-27.9888	-32.5078	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	250.2289	221.1805	235.0002	207.0257	200.8807	181.2520	179.2101	186.2920	188.2651	209.6071	222.4235	247.5818	(64)
											Total per year (kWh/year) = Sum(64)m =	2528.9476	(64)
12Total per year (kWh/year)												2529	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	117.2348	104.0754	111.3575	99.5595	97.6843	89.2795	88.9212	91.6762	91.8447	100.9300	105.5404	116.1507	(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	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.1891	164.0665	148.1891	153.1287	148.1891	153.1287	148.1891	148.1891	153.1287	148.1891	153.1287	148.1891	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	289.9549	292.9638	285.3816	269.2401	248.8644	229.7141	216.9205	213.9117	221.4939	237.6353	258.0111	277.1614	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	(71)
Water heating gains (Table 5)	157.5737	154.8741	149.6740	138.2771	131.2962	123.9993	119.5177	123.2207	127.5620	135.6587	146.5839	156.1166	(72)
Total internal gains	664.8660	681.0526	652.3929	629.7942	597.4979	572.9904	550.7756	551.4697	568.3328	590.6313	626.8719	650.6152	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3000	10.6334	0.6300	0.7000	0.7700	13.9737	(74)
Southeast	5.7500	36.7938	0.6300	0.7000	0.7700	64.6569	(77)
South	6.3000	46.7521	0.6300	0.7000	0.7700	90.0146	(78)
West	7.1500	19.6403	0.6300	0.7000	0.7700	42.9166	(80)

Solar gains	211.5618	368.2138	522.1165	673.4866	775.6121	778.5523	747.1087	670.1397	574.6938	412.1360	254.8924	180.0554	(83)

Total gains	876.4278	1049.2664	1174.5095	1303.2808	1373.1100	1351.5427	1297.8842	1221.6094	1143.0267	1002.7673	881.7643	830.6707 (84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	90.1692	90.4714	90.7697	92.1973	92.4694	93.7575	93.7575	94.0000	93.2571	92.4694	91.9206	91.3537	
alpha	7.0113	7.0314	7.0513	7.1465	7.1646	7.2505	7.2505	7.2667	7.2171	7.1646	7.1280	7.0902	
util living area	0.9985	0.9942	0.9800	0.9178	0.7665	0.5530	0.3981	0.4408	0.6942	0.9491	0.9949	0.9989	(86)
MIT	20.1539	20.3336	20.5574	20.8180	20.9594	20.9965	20.9997	20.9994	20.9841	20.7905	20.4257	20.1298	(87)
Th 2	20.0934	20.0962	20.0989	20.1116	20.1140	20.1251	20.1251	20.1272	20.1208	20.1140	20.1092	20.1041	(88)
util rest of house	0.9978	0.9919	0.9720	0.8891	0.7078	0.4792	0.3192	0.3575	0.6146	0.9243	0.9925	0.9985	(89)
MIT 2	19.1104	19.3414	19.6242	19.9423	20.0852	20.1236	20.1251	20.1270	20.1125	19.9206	19.4700	19.0880	(90)
Living area fraction									fLA = Living area / (4) =			0.2211	(91)
MIT	19.3412	19.5608	19.8306	20.1359	20.2785	20.3166	20.3185	20.3199	20.3052	20.1129	19.6813	19.3184	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3412	19.5608	19.8306	20.1359	20.2785	20.3166	20.3185	20.3199	20.3052	20.1129	19.6813	19.3184	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9900	0.9690	0.8900	0.7192	0.4955	0.3366	0.3760	0.6319	0.9242	0.9908	0.9979	(94)
Useful gains	873.8729	1038.8253	1138.1448	1159.8655	987.5866	669.7108	436.9051	459.2685	722.2318	926.7745	873.6772	828.9531	(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	1838.0693	1785.5999	1618.2514	1342.8500	1022.2387	671.8446	437.0134	459.5039	733.1824	1133.5869	1508.1742	1823.5472	(97)
Space heating kWh	717.3621	501.8325	357.1993	131.7488	25.7811	0.0000	0.0000	0.0000	0.0000	153.8684	456.8378	739.9780	(98a)
Space heating requirement - total per year (kWh/year)												3084.6082	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	717.3621	501.8325	357.1993	131.7488	25.7811	0.0000	0.0000	0.0000	0.0000	153.8684	456.8378	739.9780	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3084.6082	
Space heating per m2											(98c) / (4) =	24.9362	(99)

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 %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	717.3621	501.8325	357.1993	131.7488	25.7811	0.0000	0.0000	0.0000	0.0000	153.8684	456.8378	739.9780	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	777.2071	543.6972	386.9982	142.7398	27.9319	0.0000	0.0000	0.0000	0.0000	166.7047	494.9488	801.7097	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	250.2289	221.1805	235.0002	207.0257	200.8807	181.2520	179.2101	186.2920	188.2651	209.6071	222.4235	247.5818	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.2834	85.8384	84.9960	83.0744	80.7307	79.8000	79.8000	79.8000	79.8000	83.3773	85.6374	86.3583	(217)
Fuel for water heating, kWh/month													
	290.0082	257.6707	276.4838	249.2052	248.8283	227.1328	224.5741	233.4486	235.9212	251.3960	259.7271	286.6915	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	30.7908	24.7015	22.2410	16.2947	12.5865	10.2833	11.4818	14.9245	19.3854	25.4347	28.7285	31.6465	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.7675	-34.1021	-52.0309	-62.1943	-70.3078	-66.7813	-65.9338	-60.6102	-51.8368	-40.5555	-25.7209	-19.4549	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-7.4194	-16.0179	-32.6292	-50.2083	-67.6041	-68.4090	-67.6393	-56.7353	-40.8678	-23.3288	-10.0357	-5.8393	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													

(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3341.9374	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3041.0874	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												248.4991	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1019.0304	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												5698.4935	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3341.9374	0.2100	701.8068	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3041.0874	0.2100	638.6283	(264)
Space and water heating			1340.4352	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	248.4991	0.1443	35.8661	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-572.2961	0.1334	-76.3180	
PV Unit electricity exported	-446.7343	0.1252	-55.9223	
Total			-132.2403	(269)
Total CO2, kg/year			1255.9903	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.1500	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3341.9374	1.1300	3776.3892	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3041.0874	1.1300	3436.4287	(278)
Space and water heating			7212.8180	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	248.4991	1.5338	381.1562	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-572.2961	1.4928	-854.3143	
PV Unit electricity exported	-446.7343	0.4595	-205.2573	
Total			-1059.5715	(283)
Total Primary energy kWh/year			6664.5035	(286)
Target Primary Energy Rate (TPER)			53.8800	(287)

Full SAP Calculation Printout

Property Reference	L07-9.03 MA x3_Copy_Copy	Issued on Date	12/09/2023
Assessment Reference	L07-9.03 MA x3_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	10.56	TER	12.80
Environmental	92 A	% DER < TER			17.50
CO_2 Emissions (t/year)	0.68	DFEE	29.07	TFEE	29.40
Compliance Check	See BREL	% DFEE < TFEE			1.13
% DPER < TPER	13.03	DPER	60.44	TPER	69.50

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		72.2000 (1b)	x	2.7400 (2b)	=	197.8280 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.2000					(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8280 (5)	

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		72.8000 (23c)

Effective ac	0.2986	0.2954	0.2922	0.2762	0.2731	0.2571	0.2571	0.2539	0.2635	0.2731	0.2794	0.2858	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.30)			15.4300	1.2357	19.0675			(27)
External Wall 1	56.1426	15.4300	40.7126	0.1400	5.6998	190.0000	7735.3940	(29a)
Total net area of external elements Aum(A, m2)			56.1426					(31)

Full SAP Calculation Printout

Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	24.7673			(33)
Party Wall 1	56.0900	0.0000	0.0000	180.0000	10096.2000 (32)
Party Floor 1	72.2000			40.0000	2888.0000 (32d)
Party Ceiling 1	72.2000			30.0000	2166.0000 (32b)
Internal Wall 1	80.8300			75.0000	6062.2500 (32c)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =				28947.8440 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					400.9397 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.4800	0.0300	0.2844
E3 Sill	7.9000	0.0300	0.2370
E4 Jamb	17.0400	0.0300	0.5112
E7 Party floor between dwellings (in blocks of flats)	40.9800	0.0700	2.8686
E18 Party wall between dwellings	5.4800	0.0600	0.3288
E16 Corner (normal)	5.4800	0.0900	0.4932
E8 Balcony within a dwelling, wall insulation continuous	5.8400	0.0000	0.0000
E17 Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.4766	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	29.2439	(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	19.4911	19.2830	19.0749	18.0345	17.8264	16.7860	16.7860	16.5779	17.2021	17.8264	18.2426	18.6588	(38)
Heat transfer coeff	48.7350	48.5269	48.3188	47.2783	47.0703	46.0298	46.0298	45.8217	46.4460	47.0703	47.4864	47.9026	(39)
Average = Sum(39)m / 12 =												47.2263	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6750	0.6721	0.6692	0.6548	0.6519	0.6375	0.6375	0.6346	0.6433	0.6519	0.6577	0.6635	(40)
HLP (average)												0.6541	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2983	(42)
Hot water usage for mixer showers	86.2882	84.9915	83.1019	79.4865	76.8184	73.8429	72.1517	74.0270	76.0827	79.2774	82.9705	85.9576	(42a)
Hot water usage for baths	27.1100	26.7073	26.1404	25.0950	24.3122	23.4442	22.9754	23.5384	24.1514	25.0802	26.1471	27.0183	(42b)
Hot water usage for other uses	38.1672	36.7793	35.3914	34.0035	32.6156	31.2277	31.2277	32.6156	34.0035	35.3914	36.7793	38.1672	(42c)
Average daily hot water use (litres/day)												139.3875	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.5654	148.4781	144.6336	138.5849	133.7461	128.5148	126.3547	130.1810	134.2376	139.7489	145.8968	151.1431	(44)
Energy conte	240.0425	211.4309	222.2965	189.7158	180.0480	158.0240	152.8151	161.1912	165.5283	189.6380	207.8568	236.6536	(45)
Energy content (annual)										Total = Sum(45)m =		2315.2407	
Distribution loss (46)m = 0.15 x (45)m	36.0064	31.7146	33.3445	28.4574	27.0072	23.7036	22.9223	24.1787	24.8292	28.4457	31.1785	35.4980	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8208	(55)
Total storage loss	25.4448	22.9824	25.4448	24.6240	25.4448	24.6240	25.4448	25.4448	24.6240	25.4448	24.6240	25.4448	(56)
If cylinder contains dedicated solar storage	25.4448	22.9824	25.4448	24.6240	25.4448	24.6240	25.4448	25.4448	24.6240	25.4448	24.6240	25.4448	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	288.7497	255.4245	271.0037	236.8518	228.7552	205.1600	201.5223	209.8984	212.6643	238.3452	254.9928	285.3608	(62)
WWHRS	-65.4547	-57.8887	-60.6177	-50.1938	-46.7788	-40.0290	-37.5208	-39.8996	-41.4155	-48.8244	-55.3121	-64.2426	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	223.2950	197.5358	210.3860	186.6580	181.9764	165.1310	164.0015	169.9988	171.2488	189.5208	199.6807	221.1182	(64)
										Total per year (kWh/year) = Sum(64)m =		2280.5511	(64)
12Total per year (kWh/year)												2281	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	118.7799	105.4956	112.8794	100.7893	98.8317	90.2518	89.7768	92.5618	92.7470	102.0204	106.8212	117.6531	(65)

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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	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	102.0756	113.0123	102.0756	105.4781	102.0756	105.4781	102.0756	102.0756	105.4781	102.0756	105.4781	102.0756	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.3763	204.4763	199.1843	187.9182	173.6968	160.3307	151.4014	149.3013	154.5933	165.8594	180.0808	193.4469	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	(71)
Water heating gains (Table 5)												
	159.6504	156.9876	151.7196	139.9852	132.8383	125.3497	120.6677	124.4111	128.8152	137.1242	148.3628	158.1359 (72)
Total internal gains												
	521.5772	531.9511	510.4544	490.8564	466.0857	448.6335	431.6196	433.2629	446.3616	462.5341	491.3966	511.1333 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.3300	0.8000	0.7700	19.1622	(74)
East	5.5800	19.6403	0.3300	0.8000	0.7700	20.0502	(76)

Solar gains	39.2124	75.8424	126.8200	194.1574	250.0967	262.3267	247.0917	203.4184	149.9413	90.1320	48.6393	32.4629	(83)
Total gains	560.7896	607.7934	637.2744	685.0138	716.1824	710.9602	678.7113	636.6813	596.3029	552.6661	540.0359	543.5961	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	164.9958	165.7033	166.4170	170.0793	170.8312	174.6926	174.6926	175.4860	173.1273	170.8312	169.3340	167.8628	
alpha	11.9997	12.0469	12.0945	12.3386	12.3887	12.6462	12.6462	12.6991	12.5418	12.3887	12.2889	12.1909	
util living area													
	0.9964	0.9888	0.9596	0.8187	0.6107	0.4144	0.2984	0.3311	0.5373	0.8577	0.9834	0.9973	(86)
MIT	20.7277	20.8074	20.9048	20.9880	20.9996	21.0000	21.0000	21.0000	20.9999	20.9834	20.8620	20.7192	(87)
Th 2	20.3630	20.3655	20.3681	20.3809	20.3835	20.3963	20.3963	20.3989	20.3912	20.3835	20.3783	20.3732	(88)
util rest of house													
	0.9948	0.9840	0.9446	0.7826	0.5705	0.3753	0.2575	0.2878	0.4900	0.8174	0.9755	0.9960	(89)
MIT 2	20.1228	20.2027	20.2953	20.3738	20.3833	20.3963	20.3963	20.3989	20.3912	20.3741	20.2673	20.1238	(90)
Living area fraction									fLA = Living area / (4) =			0.3940	(91)
MIT	20.3611	20.4410	20.5355	20.6158	20.6261	20.6342	20.6342	20.6358	20.6310	20.6142	20.5017	20.3584	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3611	20.4410	20.5355	20.6158	20.6261	20.6342	20.6342	20.6358	20.6310	20.6142	20.5017	20.3584	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9947	0.9847	0.9490	0.7966	0.5863	0.3907	0.2736	0.3048	0.5087	0.8331	0.9773	0.9960	(94)
Useful gains	557.8425	598.4676	604.7666	545.7137	419.9211	277.7522	185.6938	194.0902	303.3100	460.4098	527.7807	541.3976	(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													
	782.7393	754.1575	678.1779	553.9032	420.1559	277.7534	185.6938	194.0902	303.3410	471.3701	636.3971	774.0286	(97)
Space heating kWh													
	167.3233	104.6236	54.6180	5.8964	0.1747	0.0000	0.0000	0.0000	0.0000	8.1545	78.2038	173.0775	(98a)
Space heating requirement - total per year (kWh/year)												592.0718	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	167.3233	104.6236	54.6180	5.8964	0.1747	0.0000	0.0000	0.0000	0.0000	8.1545	78.2038	173.0775	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												592.0718	
Space heating per m2											(98c) / (4) =	8.2004	(99)

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 %)												84.5000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	167.3233	104.6236	54.6180	5.8964	0.1747	0.0000	0.0000	0.0000	0.0000	8.1545	78.2038	173.0775	(98)
Space heating efficiency (main heating system 1)													
	84.5000	84.5000	84.5000	84.5000	84.5000	0.0000	0.0000	0.0000	0.0000	84.5000	84.5000	84.5000	(210)
Space heating fuel (main heating system)													
	198.0157	123.8149	64.6367	6.9780	0.2067	0.0000	0.0000	0.0000	0.0000	9.6503	92.5489	204.8254	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)

Space heating fuel (secondary)

	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

	223.2950	197.5358	210.3860	186.6580	181.9764	165.1310	164.0015	169.9988	171.2488	189.5208	199.6807	221.1182 (64)
Efficiency of water heater												89.5000 (216)
(217)m	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000	84.5000 (217)
Fuel for water heating, kWh/month												
	264.2545	233.7702	248.9776	220.8970	215.3566	195.4213	194.0846	201.1820	202.6613	224.2850	236.3086	261.6784 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	16.2936	14.7168	16.2936	15.7680	16.2936	15.7680	16.2936	16.2936	15.7680	16.2936	15.7680	16.2936 (231)
Lighting	18.7528	15.0442	13.5456	9.9241	7.6656	6.2629	6.9929	9.0896	11.8065	15.4907	17.4967	19.2739 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												700.6767 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												89.5000
Water heating fuel used												2698.8770 (219)
Space cooling fuel												0.0000 (221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)	
mechanical ventilation fans (SFP = 0.6250)	150.8439 (230a)
central heating pump	41.0000 (230c)
Total electricity for the above, kWh/year	191.8439 (231)
Electricity for lighting (calculated in Appendix L)	151.3454 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3742.7430 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	700.6767	0.2100	147.1421	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2698.8770	0.2100	566.7642	(264)
Space and water heating			713.9063	(265)
Pumps, fans and electric keep-hot	191.8439	0.1387	26.6111	(267)
Energy for lighting	151.3454	0.1443	21.8438	(268)
Total CO2, kg/year			762.3612	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.5600	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	700.6767	1.1300	791.7646	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2698.8770	1.1300	3049.7310	(278)
Space and water heating			3841.4957	(279)
Pumps, fans and electric keep-hot	191.8439	1.5128	290.2214	(281)
Energy for lighting	151.3454	1.5338	232.1387	(282)
Total Primary energy kWh/year			4363.8557	(286)
Dwelling Primary energy Rate (DPER)			60.4400	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.2000 (1b)	x	2.7400 (2b)	=	197.8280 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8280	(5)

2. Ventilation rate

			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1516	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4016	(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) =	0.3414	(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	0.4353	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3841	0.4011	(22b)
Effective ac	0.5947	0.5911	0.5875	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5738	0.5805	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			15.4300	1.1450	17.6679			(27)
External Wall 1	56.1426	15.4300	40.7126	0.1800	7.3283			(29a)
Total net area of external elements Aum(A, m2)			56.1426					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	24.9962			(33)
Party Wall 1			56.0900	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							410.9397	(35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total	
E2	Other lintels (including other steel lintels)	9.4800	0.0500	0.4740	
E3	Sill	7.9000	0.0500	0.3950	
E4	Jamb	17.0400	0.0500	0.8520	
E7	Party floor between dwellings (in blocks of flats)	40.9800	0.0700	2.8686	
E18	Party wall between dwellings	5.4800	0.0600	0.3288	
E16	Corner (normal)	5.4800	0.0900	0.4932	
E8	Balcony within a dwelling, wall insulation continuous	5.8400	0.0000	0.0000	
E17	Corner (inverted – internal area greater than external area)	2.7400	-0.0900	-0.2466	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		5.1650	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	30.1612	(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	38.8263	38.5862	38.3508	37.2451	37.0382	36.0752	36.0752	35.8969	36.4461	37.0382	37.4567	37.8942	(38)
Heat transfer coeff	68.9875	68.7474	68.5120	67.4063	67.1994	66.2364	66.2364	66.0581	66.6073	67.1994	67.6179	68.0554	(39)
Average = Sum(39)m / 12 =												67.4053	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9555	0.9522	0.9489	0.9336	0.9307	0.9174	0.9174	0.9149	0.9225	0.9307	0.9365	0.9426	(40)
HLP (average)												0.9336	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2983 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	62.7551	61.8120	60.4377	57.8083	55.8679	53.7039	52.4739	53.8378	55.3329	57.6563	60.3422	62.5146	(42a)
Hot water usage for baths	27.1100	26.7073	26.1404	25.0950	24.3122	23.4442	22.9754	23.5384	24.1514	25.0802	26.1471	27.0183	(42b)
Hot water usage for other uses	38.1672	36.7793	35.3914	34.0035	32.6156	31.2277	31.2277	32.6156	34.0035	35.3914	36.7793	38.1672	(42c)
Average daily hot water use (litres/day)												117.6907	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	128.0322	125.2986	121.9695	116.9068	112.7957	108.3758	106.6770	109.9918	113.4877	118.1278	123.2685	127.7001	(44)
Energy conte	202.7718	178.4236	187.4626	160.0395	151.8447	133.2607	129.0166	136.1928	139.9417	160.2984	175.6186	199.9476	(45)
Energy content (annual)										Total = Sum(45)m =		1954.8185	
Distribution loss (46)m = 0.15 x (45)m	30.4158	26.7635	28.1194	24.0059	22.7767	19.9891	19.3525	20.4289	20.9913	24.0448	26.3428	29.9921	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	252.0144	222.9008	236.7052	207.6937	201.0873	180.9149	178.2593	185.4355	187.5959	209.5410	223.2728	249.1902	(62)
WWHRS	-28.6890	-25.3728	-26.5689	-22.0001	-20.5033	-17.5448	-16.4455	-17.4881	-18.1526	-21.3999	-24.2435	-28.1577	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	223.3254	197.5280	210.1363	185.6936	180.5840	163.3701	161.8138	167.9473	169.4434	188.1412	199.0294	221.0325	(64)
										Total per year (kWh/year) = Sum(64)m =		2268.0450	(64)
12Total per year (kWh/year)												2268	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	106.8157	94.9076	101.7254	91.3365	89.8825	82.4326	82.2922	84.6782	84.6540	92.6933	96.5166	105.8767	(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	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	102.2420	113.1965	102.2420	105.6501	102.2420	105.6501	102.2420	102.2420	105.6501	102.2420	105.6501	102.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.3763	204.4763	199.1843	187.9182	173.6968	160.3307	151.4014	149.3013	154.5933	165.8594	180.0808	193.4469	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	(71)
Water heating gains (Table 5)	143.5695	141.2316	136.7277	126.8563	120.8098	114.4897	110.6077	113.8148	117.5750	124.5878	134.0508	142.3074	(72)
Total internal gains	508.6628	519.3794	498.6290	480.8995	457.2236	437.9454	421.7260	422.8331	435.2933	453.1642	480.2566	498.4712	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.6300	0.7000	0.7700	32.0096	(74)
East	5.5800	19.6403	0.6300	0.7000	0.7700	33.4929	(76)
Solar gains	65.5025	126.6912	211.8470	324.3312	417.7752	438.2049	412.7555	339.8012	250.4701	150.5614	81.2497	54.2277	(83)
Total gains	574.1653	646.0706	710.4760	805.2307	874.9987	876.1503	834.4815	762.6343	685.7635	603.7255	561.5063	552.6990	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	119.4654	119.8827	120.2947	122.2679	122.6443	124.4274	124.4274	124.7633	123.7345	122.6443	121.8852	121.1016

alpha	8.9644	8.9922	9.0196	9.1512	9.1763	9.2952	9.2952	9.3176	9.2490	9.1763	9.1257	9.0734	
util living area	0.9990	0.9967	0.9857	0.9072	0.7046	0.4835	0.3492	0.3984	0.6646	0.9541	0.9963	0.9993	(86)
MIT	20.4171	20.5334	20.7044	20.9140	20.9915	20.9997	21.0000	21.0000	20.9962	20.8758	20.6158	20.4035	(87)
Th 2	20.1206	20.1234	20.1261	20.1390	20.1414	20.1527	20.1527	20.1548	20.1484	20.1414	20.1366	20.1314	(88)
util rest of house	0.9985	0.9950	0.9782	0.8718	0.6440	0.4197	0.2820	0.3252	0.5857	0.9266	0.9940	0.9989	(89)
MIT 2	19.4507	19.6011	19.8174	20.0670	20.1365	20.1526	20.1527	20.1548	20.1468	20.0354	19.7175	19.4423	(90)
Living area fraction									fLA = Living area / (4) =			0.3940	(91)
MIT	19.8315	19.9685	20.1669	20.4007	20.4734	20.4864	20.4866	20.4878	20.4815	20.3666	20.0714	19.8211	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8315	19.9685	20.1669	20.4007	20.4734	20.4864	20.4866	20.4878	20.4815	20.3666	20.0714	19.8211	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9946	0.9787	0.8835	0.6678	0.4449	0.3085	0.3541	0.6170	0.9350	0.9938	0.9987	(94)
Useful gains	573.1706	642.5555	695.3108	711.4282	584.3402	389.7799	257.4305	270.0241	423.1020	564.4624	558.0180	551.9962	(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	1071.4788	1035.9178	936.3486	775.2219	589.5694	389.8965	257.4336	270.0351	425.0536	656.3071	877.1015	1063.0992	(97)
Space heating kWh	370.7413	264.3395	179.3321	45.9314	3.8905	0.0000	0.0000	0.0000	0.0000	68.3325	229.7401	380.2606	(98a)
Space heating requirement - total per year (kWh/year)												1542.5681	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	370.7413	264.3395	179.3321	45.9314	3.8905	0.0000	0.0000	0.0000	0.0000	68.3325	229.7401	380.2606	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1542.5681	
Space heating per m2											(98c) / (4) =	21.3652	(99)

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 %)	92.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	370.7413	264.3395	179.3321	45.9314	3.8905	0.0000	0.0000	0.0000	0.0000	68.3325	229.7401	380.2606	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	401.6699	286.3917	194.2927	49.7632	4.2150	0.0000	0.0000	0.0000	0.0000	74.0330	248.9059	411.9834	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	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	223.3254	197.5280	210.1363	185.6936	180.5840	163.3701	161.8138	167.9473	169.4434	188.1412	199.0294	221.0325	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.1882	84.7139	83.7064	81.4367	79.9709	79.8000	79.8000	79.8000	79.8000	82.0147	84.3824	85.2651	(217)
Fuel for water heating, kWh/month	262.1553	233.1707	251.0398	228.0220	225.8121	204.7244	202.7742	210.4603	212.3350	229.3994	235.8659	259.2298	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	21.2439	17.0426	15.3450	11.2424	8.6840	7.0949	7.9218	10.2970	13.3748	17.5485	19.8210	21.8343	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-7.9741	-12.3677	-19.5340	-24.2038	-28.1474	-27.0385	-26.7111	-24.1766	-20.1180	-15.0681	-9.1566	-6.7694	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-1.6363	-3.5888	-7.4189	-11.5813	-15.7591	-16.0014	-15.8140	-13.1822	-9.3959	-5.2705	-2.2271	-1.2834	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1671.2547	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												2754.9890	(219)

Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	171.4502 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-324.4242 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4359.2697 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1671.2547	0.2100	350.9635	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2754.9890	0.2100	578.5477	(264)
Space and water heating			929.5112	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	171.4502	0.1443	24.7456	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-221.2652	0.1327	-29.3509	
PV Unit electricity exported	-103.1590	0.1248	-12.8728	
Total			-42.2238	(269)
Total CO2, kg/year			923.9622	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.8000	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1671.2547	1.1300	1888.5178	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2754.9890	1.1300	3113.1375	(278)
Space and water heating			5001.6553	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	171.4502	1.5338	262.9761	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-221.2652	1.4901	-329.7166	
PV Unit electricity exported	-103.1590	0.4580	-47.2465	
Total			-376.9631	(283)
Total Primary energy kWh/year			5017.7691	(286)
Target Primary Energy Rate (TPER)			69.5000	(287)

Full SAP Calculation Printout

Property Reference	LEAN PLANNING	Issued on Date	12/09/2023
Assessment Reference	L01to5 - 09 x5_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	10.58	TER	11.66
Environmental	91 B	% DER < TER			9.26
CO_2 Emissions (t/year)	0.75	DFEE	22.43	TFEE	22.07
Compliance Check	See BREL	% DFEE < TFEE			-1.66
% DPER < TPER	3.02	DPER	55.78	TPER	57.52

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

1. Overall dwelling characteristics
                                                                    Area          Storey height              Volume
                                                                    (m2)               (m)                   (m3)
Ground floor                                                    76.3000 (1b)    x      2.7400 (2b)    =    209.0620 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              76.3000                                          (4)
Dwelling volume                                                                (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    209.0620 (5)

2. Ventilation rate
                                                                                                          m3 per hour
Number of open chimneys                                                                          0 * 80 =      0.0000 (6a)
Number of open flues                                                                             0 * 20 =      0.0000 (6b)
Number of chimneys / flues attached to closed fire                                               0 * 10 =      0.0000 (6c)
Number of flues attached to solid fuel boiler                                                    0 * 20 =      0.0000 (6d)
Number of flues attached to other heater                                                         0 * 35 =      0.0000 (6e)
Number of blocked chimneys                                                                       0 * 20 =      0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =      0.0000 / (5) =      0.0000 (8)
Pressure test                                                                                                        Yes
Pressure Test Method                                                                                          Blower Door
Measured/design AP50                                                                                                3.0000 (17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)             0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                       72.8000 (23c)

Effective ac  0.2986    0.2954    0.2922    0.2762    0.2731    0.2571    0.2571    0.2539    0.2635    0.2731    0.2794    0.2858 (25)

3. Heat losses and heat loss parameter
Element                                          Gross       Openings        NetArea        U-value          A x U        K-value          A x K
                                                   m2            m2             m2          W/m2K            W/K          kJ/m2K           kJ/K
glazing (Uw = 1.30)                                                          12.7700        1.2357         15.7804                          (27)
External Wall 1                                 47.8404       12.7700        35.0704        0.1400          4.9099       190.0000      6663.3760 (29a)
Total net area of external elements Aum(A, m2)                               47.8404                                                      (31)
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Full SAP Calculation Printout

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Fabric heat loss, W/K = Sum (A x U)                                  (26)...(30) + (32) =     20.6903                    (33)
Party Wall 1                                                      17.4400        0.0000         0.0000      180.0000     3139.2000 (32)
Party Floor 1                                                     76.3000                                    40.0000     3052.0000 (32d)
Party Ceiling 1                                                   76.3000                                    30.0000     2289.0000 (32b)
Internal Wall 1                                                  155.5200                                     9.0000     1399.6800 (32c)

Heat capacity Cm = Sum(A x k)                                                (28)...(30) + (32) + (32a)...(32e) =  16543.2560 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                  216.8186 (35)
List of Thermal Bridges
        K1 Element                                                                    Length      Psi-value          Total
        E2 Other lintels (including other steel lintels)                              7.0000         0.0300         0.2100
        E3 Sill                                                                       4.7400         0.0300         0.1422
        E4 Jamb                                                                      13.9400         0.0300         0.4182
        E7 Party floor between dwellings (in blocks of flats)                        34.9200         0.0700         2.4444
        E8 Balcony within a dwelling, wall insulation continuous                      5.1400         0.0000         0.0000
        E16 Corner (normal)                                                           2.7400         0.0900         0.2466
        E18 Party wall between dwellings                                              5.4800         0.0600         0.3288
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                         3.7902 (36)
Point Thermal bridges                                                                                 (36a) =      0.0000
Total fabric heat loss                                                                (33) + (36) + (36a) =     24.4805 (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         20.5980   20.3781   20.1582   19.0586   18.8387   17.7392   17.7392   17.5193   18.1790   18.8387   19.2785   19.7183 (38)
Heat transfer coeff
              45.0784   44.8585   44.6386   43.5391   43.3192   42.2196   42.2196   41.9997   42.6595   43.3192   43.7590   44.1988 (39)
Average = Sum(39)m / 12 =                                                                                          43.4841

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP            0.5908    0.5879    0.5850    0.5706    0.5677    0.5533    0.5533    0.5505    0.5591    0.5677    0.5735    0.5793 (40)
HLP (average)                                                                                                      0.5699
Days in mont        31        28        31        30        31        30        31        31        30        31        30        31

4. Water heating energy requirements (kWh/year)
Assumed occupancy                                                                                                  2.3889 (42)
Hot water usage for mixer showers
              88.3765   87.0484   85.1131   81.4101   78.6775   75.6300   73.8979   75.8186   77.9240   81.1960   84.9785   88.0379 (42a)
Hot water usage for baths
              27.7631   27.3508   26.7701   25.6995   24.8979   24.0090   23.5289   24.1054   24.7332   25.6844   26.7770   27.6692 (42b)
Hot water usage for other uses
              39.0948   37.6732   36.2516   34.8299   33.4083   31.9867   31.9867   33.4083   34.8299   36.2516   37.6732   39.0948 (42c)
Average daily hot water use (litres/day)                                                                         142.7617 (43)

                 Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
              155.2345  152.0724  148.1348  141.9396  136.9837  131.6257  129.4134  133.3323  137.4872  143.1320  149.4287  154.8020 (44)
Energy conte  245.8534  216.5490  227.6776  194.3083  184.4064  161.8492  156.5143  165.0933  169.5354  194.2287  212.8886  242.3825 (45)
Energy content (annual)                                                                  Total = Sum(45)m =   2371.2867
Distribution loss  (46)m = 0.15 x (45)m
              36.8780   32.4824   34.1516   29.1462   27.6610   24.2774   23.4771   24.7640   25.4303   29.1343   31.9333   36.3574 (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)
Combi loss     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (61)
Total heat required for water heating calculated for each month
              301.1302  266.4765  282.9544  247.8019  239.6832  215.3429  211.7911  220.3701  223.0291  249.5055  266.3823  297.6593 (62)
WWHRS        -67.0388  -59.2897  -62.0847  -51.4086  -47.9110  -40.9978  -38.4289  -40.8652  -42.4179  -50.0060  -56.6507  -65.7973 (63a)
PV diverter    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63b)
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 (63c)
FGHRS          0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63d)
Output from w/h
              234.0914  207.1868  220.8697  196.3933  191.7722  174.3451  173.3623  179.5048  180.6112  199.4996  209.7316  231.8620 (64)
                                                                                        Total per year (kWh/year) = Sum(64)m =  2399.2300 (64)
12Total per year (kWh/year)                                                                                        2399 (64)
Electric shower(s)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (64a)
                                                                  Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =    0.0000 (64a)
Heat gains from water heating, kWh/month
              125.9677  111.9445  119.9243  107.4024  105.5366   96.6098   96.2625   99.1149   99.1655  108.8025  113.5804  124.8136 (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         119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              108.0126  119.5854  108.0126  111.6131  108.0126  111.6131  108.0126  108.0126  111.6131  108.0126  111.6131  108.0126 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
```

	211.5344	213.7294	208.1979	196.4220	181.5571	167.5861	158.2527	156.0576	161.5891	173.3650	188.2299	202.2009 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445 (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)												
	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564 (71)
Water heating gains (Table 5)												
	169.3114	166.5841	161.1885	149.1701	141.8502	134.1803	129.3850	133.2190	137.7298	146.2399	157.7506	167.7603 (72)
Total internal gains												
	547.6921	558.7326	536.2327	516.0388	490.2536	472.2131	454.4840	456.1229	469.7656	486.4512	516.4272	536.8074 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	5.0000	46.7521	0.3300	0.8000	0.7700	42.7669	(78)
West	7.7700	19.6403	0.3300	0.8000	0.7700	27.9194	(80)

Solar gains	70.6863	124.6574	179.1652	232.0176	265.8449	265.6968	255.4843	230.5385	197.8107	140.3527	85.5055	59.9141 (83)
Total gains	618.3784	683.3900	715.3979	748.0564	756.0985	737.9099	709.9683	686.6615	667.5764	626.8039	601.9327	596.7215 (84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	101.9412	102.4409	102.9456	105.5454	106.0812	108.8439	108.8439	109.4137	107.7217	106.0812	105.0150	103.9700	
alpha	7.7961	7.8294	7.8630	8.0364	8.0721	8.2563	8.2563	8.2942	8.1814	8.0721	8.0010	7.9313	
util living area													
	0.9532	0.9097	0.8381	0.6913	0.5313	0.3661	0.2617	0.2814	0.4406	0.7040	0.8935	0.9596	(86)
MIT	20.7106	20.8218	20.9154	20.9827	20.9979	20.9999	21.0000	21.0000	20.9996	20.9835	20.8748	20.6982	(87)
Th 2	20.4383	20.4409	20.4435	20.4565	20.4591	20.4722	20.4722	20.4748	20.4669	20.4591	20.4539	20.4487	(88)
util rest of house													
	0.9444	0.8954	0.8167	0.6633	0.5009	0.3360	0.2303	0.2492	0.4067	0.6713	0.8753	0.9519	(89)
MIT 2	20.1842	20.2898	20.3758	20.4441	20.4578	20.4721	20.4722	20.4748	20.4668	20.4478	20.3517	20.1820	(90)
Living area fraction										fLA = Living area / (4) =		0.3662	(91)
MIT	20.3770	20.4846	20.5734	20.6413	20.6556	20.6654	20.6655	20.6671	20.6619	20.6440	20.5432	20.3711	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3770	20.4846	20.5734	20.6413	20.6556	20.6654	20.6655	20.6671	20.6619	20.6440	20.5432	20.3711	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9434	0.8966	0.8218	0.6729	0.5119	0.3470	0.2418	0.2610	0.4191	0.6826	0.8784	0.9507	(94)
Useful gains	583.3780	612.6974	587.9257	503.3611	387.0823	256.0526	171.6411	179.2157	279.7942	427.8451	528.7500	567.3049	(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													
	724.7238	699.1016	628.2154	511.2056	387.9491	256.0794	171.6421	179.2177	279.9269	435.0965	588.2614	714.7412	(97)
Space heating kWh													
	105.1613	58.0636	29.9755	5.6480	0.6449	0.0000	0.0000	0.0000	0.0000	5.3950	42.8482	109.6926	(98a)
Space heating requirement - total per year (kWh/year)												357.4292	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	105.1613	58.0636	29.9755	5.6480	0.6449	0.0000	0.0000	0.0000	0.0000	5.3950	42.8482	109.6926	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												357.4292	
Space heating per m2											(98c) / (4) =	4.6845	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0500	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		

	105.1613	58.0636	29.9755	5.6480	0.6449	0.0000	0.0000	0.0000	0.0000	5.3950	42.8482	109.6926 (98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25												
307a	77.0175	42.5244	21.9533	4.1365	0.4723	0.0000	0.0000	0.0000	0.0000	3.9512	31.3810	80.3361
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25												
307b	61.0067	33.6842	17.3895	3.2766	0.3741	0.0000	0.0000	0.0000	0.0000	3.1298	24.8573	63.6354
Space heating requirement												

	138.0242	76.2085	39.3429	7.4131	0.8464	0.0000	0.0000	0.0000	0.0000	7.0810	56.2383	143.9715 (307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement												
	234.0914	207.1868	220.8697	196.3933	191.7722	174.3451	173.3623	179.5048	180.6112	199.4996	209.7316	231.8620 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25												
310a	171.4427	151.7384	161.7595	143.8336	140.4492	127.6860	126.9662	131.4648	132.2752	146.1085	153.6021	169.8099
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25												
310b	135.8023	120.1942	128.1320	113.9327	111.2519	101.1420	100.5718	104.1352	104.7771	115.7347	121.6705	134.5089
Water heating fuel												
	307.2450	271.9327	289.8915	257.7663	251.7010	228.8279	227.5380	235.6001	237.0523	261.8432	275.2727	304.3188 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	13.5389	12.2287	13.5389	13.1022	13.5389	13.1022	13.5389	13.5389	13.1022	13.5389	13.1022	13.5389 (331)
Lighting	19.8435	15.9192	14.3334	10.5013	8.1115	6.6272	7.3996	9.6183	12.4932	16.3917	18.5144	20.3950 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												469.1258 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												3148.9894 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												4.6913 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)												
mechanical ventilation fans (SFP = 0.6250)												159.4098 (330a)
Total electricity for the above, kWh/year												159.4098 (331)
Electricity for lighting (calculated in Appendix L)												160.1482 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												3937.6732 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	524.5936	0.2100	110.1647	(363)
less credit emissions for electricity	-167.8700	0.3480	-58.4187	(364)
Water heating from Combined Heat and Power	3521.3148	0.2100	739.4761	(365)
less credit emissions for electricity	-1126.8207	0.3480	-392.1336	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	1703.0958	0.2100	46.3730	(368)
Electrical energy for heat distribution (space & water)	4.6913	0.0000	5.1764	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			761.9149	(373)
Space and water heating			761.9149	(376)
Pumps, fans and electric keep-hot	159.4098	0.1387	22.1121	(378)
Energy for lighting	160.1482	0.1443	23.1143	(379)
Total CO2, kg/year			807.1413	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.5800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	524.5936	1.1300	592.7908	(463)
less credit emissions for electricity	-167.8700	2.1490	-360.7525	(464)
Water heating from Combined Heat and Power	3521.3148	1.1300	3979.0857	(465)
less credit emissions for electricity	-1126.8207	2.1490	-2421.5377	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	1703.0958	1.1300	249.5310	(468)
Electrical energy for heat distribution (space & water)	4.6913	0.0000	55.3239	(472)
Overall CO2 factor for heat network			1.0418	(486)

Total CO2 associated with community systems			3769.4083 (473)
Space and water heating			3769.4083 (476)
Pumps, fans and electric keep-hot	159.4098	1.5128	241.1551 (478)
Energy for lighting	160.1482	1.5338	245.6406 (479)
Total Primary energy kWh/year			4256.2040 (483)
Dwelling Primary energy Rate (DPER)			55.7800 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		76.3000 (1b)	x	2.7400 (2b)	=	209.0620 (1b) -	(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.3000						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	209.0620	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1435	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3935	(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) =	0.3345	(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	0.4265	0.4181	0.4097	0.3679	0.3596	0.3177	0.3177	0.3094	0.3345	0.3596	0.3763	0.3930	(22b)
Effective ac	0.5909	0.5874	0.5839	0.5677	0.5646	0.5505	0.5505	0.5479	0.5559	0.5646	0.5708	0.5772	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			12.7700	1.1450	14.6221			(27)
External Wall 1	47.8404	12.7700	35.0704	0.1800	6.3127			(29a)
Total net area of external elements Aum(A, m2)			47.8404					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	20.9348			(33)
Party Wall 1			17.4400	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							226.8186	(35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	7.0000	0.0500	0.3500	
E3 Sill	4.7400	0.0500	0.2370	
E4 Jamb	13.9400	0.0500	0.6970	
E7 Party floor between dwellings (in blocks of flats)	34.9200	0.0700	2.4444	
E8 Balcony within a dwelling, wall insulation continuous	5.1400	0.0000	0.0000	
E16 Corner (normal)	2.7400	0.0900	0.2466	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.3038	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	25.2386	(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	40.7686	40.5250	40.2862	39.1647	38.9549	37.9780	37.9780	37.7971	38.3543	38.9549	39.3794	39.8232	(38)
Heat transfer coeff	66.0072	65.7636	65.5248	64.4033	64.1935	63.2166	63.2166	63.0358	63.5929	64.1935	64.6180	65.0618	(39)
Average = Sum(39)m / 12 =												64.4023	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8651	0.8619	0.8588	0.8441	0.8413	0.8285	0.8285	0.8262	0.8335	0.8413	0.8469	0.8527	(40)
HLP (average)												0.8441	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3889	(42)
Hot water usage for mixer showers	64.2739	63.3079	61.9004	59.2074	57.2200	55.0037	53.7439	55.1408	56.6720	59.0517	61.8025	64.0276	(42a)
Hot water usage for baths	27.7631	27.3508	26.7701	25.6995	24.8979	24.0090	23.5289	24.1054	24.7332	25.6844	26.7770	27.6692	(42b)
Hot water usage for other uses	39.0948	37.6732	36.2516	34.8299	33.4083	31.9867	31.9867	33.4083	34.8299	36.2516	37.6732	39.0948	(42c)
Average daily hot water use (litres/day)												120.5398	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	131.1318	128.3319	124.9221	119.7369	115.5262	110.9993	109.2595	112.6545	116.2352	120.9876	126.2527	130.7916	(44)
Energy conte	207.6807	182.7429	192.0006	163.9138	155.5205	136.4866	132.1398	139.4898	143.3296	164.1790	179.8702	204.7881	(45)
Energy content (annual)										Total = Sum(45)m =		2002.1417	
Distribution loss (46)m = 0.15 x (45)m	31.1521	27.4114	28.8001	24.5871	23.3281	20.4730	19.8210	20.9235	21.4994	24.6269	26.9805	30.7182	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	252.3207	223.0629	236.6406	207.1138	200.1605	179.6866	176.7798	184.1298	186.5296	208.8190	223.0702	249.4281	(62)
WWHRS	-29.3833	-25.9869	-27.2119	-22.5326	-20.9995	-17.9694	-16.8435	-17.9114	-18.5919	-21.9178	-24.8302	-28.8392	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	222.9373	197.0761	209.4287	184.5812	179.1609	161.7172	159.9363	166.2185	167.9377	186.9013	198.2400	220.5889	(64)
											Total per year (kWh/year) = Sum(64)m =	2254.7241	(64)
12Total per year (kWh/year)												2255	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	104.7658	93.0180	99.5522	89.0613	87.4226	79.9418	79.6485	82.0924	82.2171	90.3015	94.3668	103.8040	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	110.3566	122.1805	110.3566	114.0351	110.3566	114.0351	110.3566	110.3566	114.0351	110.3566	114.0351	110.3566	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	211.5344	213.7294	208.1979	196.4220	181.5571	167.5861	158.2527	156.0576	161.5891	173.3650	188.2299	202.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	(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)	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	(71)
Water heating gains (Table 5)	140.8143	138.4197	133.8067	123.6963	117.5034	111.0303	107.0544	110.3392	114.1904	121.3730	131.0650	139.5216	(72)
Total internal gains	521.5389	533.1632	511.1949	492.9871	468.2507	451.4852	434.4973	435.5870	448.6483	463.9282	492.1638	510.9127	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

South				5.0000	46.7521	0.6300	0.7000	0.7700				71.4402 (78)
West				7.7700	19.6403	0.6300	0.7000	0.7700				46.6380 (80)
Solar gains	118.0782	208.2345	299.2872	387.5748	444.0819	443.8344	426.7749	385.1042	330.4339	234.4528	142.8331	100.0837 (83)
Total gains	639.6171	741.3977	810.4821	880.5619	912.3326	895.3196	861.2722	820.6912	779.0821	698.3811	634.9969	610.9964 (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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.8298	73.0996	73.3660	74.6436	74.8876	76.0447	76.0447	76.2630	75.5948	74.8876	74.3956	73.8882	
alpha	5.8553	5.8733	5.8911	5.9762	5.9925	6.0696	6.0696	6.0842	6.0397	5.9925	5.9597	5.9259	
util living area	0.9822	0.9595	0.9134	0.7995	0.6356	0.4499	0.3227	0.3529	0.5554	0.8370	0.9593	0.9857	(86)
MIT	20.2387	20.4417	20.6626	20.8786	20.9723	20.9971	20.9997	20.9995	20.9902	20.8659	20.5340	20.2098	(87)
Th 2	20.1973	20.2000	20.2027	20.2153	20.2177	20.2287	20.2287	20.2307	20.2244	20.2177	20.2129	20.2079	(88)
util rest of house	0.9777	0.9501	0.8948	0.7648	0.5878	0.3965	0.2663	0.2941	0.4961	0.7992	0.9481	0.9820	(89)
MIT 2	19.3236	19.5777	19.8464	20.1008	20.1959	20.2270	20.2286	20.2305	20.2182	20.0950	19.7055	19.2957	(90)
Living area fraction									fLA = Living area / (4) =			0.3662	(91)
MIT	19.6587	19.8941	20.1453	20.3856	20.4803	20.5090	20.5109	20.5121	20.5009	20.3773	20.0089	19.6304	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6587	19.8941	20.1453	20.3856	20.4803	20.5090	20.5109	20.5121	20.5009	20.3773	20.0089	19.6304	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9740	0.9459	0.8933	0.7727	0.6041	0.4160	0.2870	0.3156	0.5175	0.8075	0.9447	0.9787	(94)
Useful gains	622.9942	701.2915	724.0330	680.3683	551.1850	372.4656	247.1458	259.0489	403.1586	563.9208	599.9110	597.9703	(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	1013.7829	986.0648	894.1078	739.7100	563.6348	373.5483	247.2362	259.2087	407.0525	627.6392	834.1455	1003.9306	(97)
Space heating kWh	290.7468	191.3677	126.5357	42.7260	9.2627	0.0000	0.0000	0.0000	0.0000	47.4065	168.6488	302.0344	(98a)
Space heating requirement - total per year (kWh/year)												1178.7286	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	290.7468	191.3677	126.5357	42.7260	9.2627	0.0000	0.0000	0.0000	0.0000	47.4065	168.6488	302.0344	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1178.7286	
Space heating per m2											(98c) / (4) =	15.4486	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
290.7468 191.3677 126.5357 42.7260 9.2627 0.0000 0.0000 0.0000 0.0000 47.4065 168.6488 302.0344		(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25		
307a 202.7959 133.4789 88.2586 29.8014 6.4607 0.0000 0.0000 0.0000 0.0000 33.0660 117.6326 210.6690		
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25		
307b 160.6376 105.7306 69.9109 23.6061 5.1176 0.0000 0.0000 0.0000 0.0000 26.1921 93.1785 166.8740		
Space heating requirement		
363.4336 239.2096 158.1696 53.4075 11.5784 0.0000 0.0000 0.0000 0.0000 59.2581 210.8111 377.5430		(307)
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 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(309)
Water heating		
Annual water heating requirement		
222.9373 197.0761 209.4287 184.5812 179.1609 161.7172 159.9363 166.2185 167.9377 186.9013 198.2400 220.5889		(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25		
310a 155.4988 137.4606 146.0765 128.7454 124.9647 112.7977 111.5556 115.9374 117.1365 130.3636 138.2724 153.8608		
Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25		
310b 123.1729 108.8845 115.7094 101.9811 98.9864 89.3488 88.3648 91.8357 92.7856 103.2629 109.5276 121.8754		
Water heating fuel		
278.6717 246.3451 261.7859 230.7265 223.9512 202.1465 199.9204 207.7731 209.9221 233.6266 247.8000 275.7362		(310)
Cooling System Energy Efficiency Ratio	0.0000	(314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(315)
Pumps and Fa 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(331)
Lighting 22.9299 18.3952 16.5629 12.1347 9.3732 7.6580 8.5505 11.1143 14.4364 18.9413 21.3941 23.5672		(332)
Electricity generated by PVs (Appendix M) (negative quantity)		
(333a)m -7.7606 -12.0565 -19.0696 -23.6564 -27.5257 -26.4350 -26.1049 -23.6166 -19.6412 -14.6930 -8.9155 -6.5855		(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)		

(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	-1.5492	-3.4009	-7.0402	-11.0094	-15.0073	-15.2587	-15.0900	-12.5736	-8.9495	-5.0094	-2.1122	-1.2154 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												1473.4108 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2818.4052 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												14.7341 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (331)
Electricity for lighting (calculated in Appendix L)												185.0576 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-314.2766 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												4162.5970 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	1647.6217	0.2100	346.0006	(363)
less credit emissions for electricity	-527.2389	0.3480	-183.4792	(364)
Water heating from Combined Heat and Power	3151.6435	0.2100	661.8451	(365)
less credit emissions for electricity	-1008.5259	0.3480	-350.9670	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2020.2158	0.2100	145.6464	(368)
Electrical energy for heat distribution (space & water)	14.7341	0.0000	6.2922	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			903.9371	(373)
Space and water heating			903.9371	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	185.0576	0.1443	26.7095	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-216.0607	0.1326	-28.6570	
PV Unit electricity exported	-98.2158	0.1247	-12.2494	
Total			-40.9064	(380)
Total CO2, kg/year			889.7402	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			11.6600	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	1647.6217	1.1300	1861.8125	(463)
less credit emissions for electricity	-527.2389	2.1490	-1133.0365	(464)
Water heating from Combined Heat and Power	3151.6435	1.1300	3561.3571	(465)
less credit emissions for electricity	-1008.5259	2.1490	-2167.3222	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2020.2158	1.1300	783.7165	(468)
Electrical energy for heat distribution (space & water)	14.7341	0.0000	66.1940	(472)
Overall CO2 factor for heat network			1.0419	(486)
Total CO2 associated with community systems			4471.8489	(473)
Space and water heating			4471.8489	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	185.0576	1.5338	283.8475	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-216.0607	1.4901	-321.9478	
PV Unit electricity exported	-98.2158	0.4577	-44.9579	
Total			-366.9057	(480)
Total Primary energy kWh/year			4388.7907	(483)
Target Primary Energy Rate (TPER)			57.5200	(484)

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Property Reference	LEAN PLANNING			Issued on Date	12/09/2023
Assessment Reference	L011 - 01,2 x2_Copy_Copy		Prop Type Ref		
Property					
SAP Rating	86 B	DER	12.15	TER	13.34
Environmental	91 B	% DER < TER			8.92
CO_2 Emissions (t/year)	0.62	DFEE	16.92	TFEE	21.17
Compliance Check	See BREL	% DFEE < TFEE			20.07
% DPER < TPER	3.64	DPER	63.57	TPER	65.97
Assessor Details	Mr. Richard Denteh			Assessor ID	U148-0001
Client					

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		51.9000 (1b)	x	2.7400 (2b)	=	142.2060 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.9000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.2060	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
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) =	0.1162	(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	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2842	0.2813	0.2784	0.2639	0.2610	0.2464	0.2464	0.2435	0.2522	0.2610	0.2668	0.2726	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
glazing (Uw = 1.30)			7.7700	1.2357	9.6017			(27)
External Wall 1	19.2348	7.7700	11.4648	0.1400	1.6051	190.0000	2178.3120	(29a)
External Roof 1	51.9000		51.9000	0.1000	5.1900	9.0000	467.1000	(30)

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Total net area of external elements Aum(A, m2)	71.1348				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	16.3968			(33)
Party Wall 1	58.5300	0.0000	0.0000	180.0000	10535.4000 (32)
Party Floor 1	51.9000			40.0000	2076.0000 (32d)
Internal Wall 1	70.2000			75.0000	5265.0000 (32c)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =				20521.8120 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					395.4106 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	3.8400	0.0300	0.1152	
E3 Sill	1.5600	0.0300	0.0468	
E4 Jamb	7.7400	0.0300	0.2322	
E7 Party floor between dwellings (in blocks of flats)	7.0100	0.0700	0.4907	
E9 Balcony between dwellings, wall insulation continuous	7.0100	0.0200	0.1402	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	
E14 Flat roof	7.0100	0.0800	0.5608	
P4 Party wall - Roof (insulation at ceiling level)	21.3500	0.1200	2.5620	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.4767	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	20.8735	(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	13.3378	13.2014	13.0650	12.3831	12.2467	11.5648	11.5648	11.4284	11.8376	12.2467	12.5195	12.7923	(38)
Heat transfer coeff	34.2113	34.0749	33.9385	33.2566	33.1202	32.4383	32.4383	32.3019	32.7111	33.1202	33.3930	33.6658	(39)
Average = Sum(39)m / 12 =												33.2225	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6592	0.6565	0.6539	0.6408	0.6382	0.6250	0.6250	0.6224	0.6303	0.6382	0.6434	0.6487	(40)
HLP (average)												0.6401	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.7461 (42)
Hot water usage for mixer showers	73.5573	72.4519	70.8410	67.7590	65.4846	62.9481	61.5064	63.1051	64.8575	67.5808	70.7290	73.2755 (42a)
Hot water usage for baths	23.1283	22.7849	22.3012	21.4093	20.7415	20.0010	19.6010	20.0813	20.6043	21.3967	22.3069	23.0502 (42b)
Hot water usage for other uses	32.5120	31.3298	30.1475	28.9653	27.7830	26.6007	26.6007	27.7830	28.9653	30.1475	31.3298	32.5120 (42c)
Average daily hot water use (litres/day)												118.8174 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1977	126.5665	123.2897	118.1336	114.0091	109.5499	107.7082	110.9694	114.4270	119.1250	124.3657	128.8376	(44)
Energy conte	204.6175	180.2290	189.4917	161.7190	153.4781	134.7043	130.2637	137.4033	141.0999	161.6515	177.1817	201.7286	(45)
Energy content (annual)										Total = Sum(45)m =		1973.5683	
Distribution loss (46)m = 0.15 x (45)m	30.6926	27.0343	28.4238	24.2578	23.0217	20.2057	19.5396	20.6105	21.1650	24.2477	26.5773	30.2593	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	259.8943	230.1564	244.7685	215.2126	208.7549	188.1980	185.5405	192.6801	194.5936	216.9283	230.6754	257.0054	(62)
WWHRS	-55.7975	-49.3478	-51.6742	-42.7882	-39.8771	-34.1231	-31.9850	-34.0128	-35.3051	-41.6208	-47.1513	-54.7642	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	204.0968	180.8086	193.0943	172.4244	168.8778	154.0749	153.5555	158.6672	159.2885	175.3075	183.5241	202.2412	(64)
									Total per year (kWh/year) = Sum(64)m =			2105.9609	(64)
12Total per year (kWh/year)												2106	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	112.2568	99.8681	107.2274	96.5665	95.2529	87.5841	87.5341	89.9080	89.7107	97.9706	101.7079	111.2962	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.0664	87.5378	79.0664	81.7020	79.0664	81.7020	79.0664	79.0664	81.7020	79.0664	81.7020	79.0664	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	152.1665	153.7456	149.7665	141.2955	130.6025	120.5525	113.8385	112.2595	116.2386	124.7095	135.4026	145.4526 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306 (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)												
	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448 (71)
Water heating gains (Table 5)												
	150.8827	148.6132	144.1229	134.1201	128.0281	121.6446	117.6534	120.8441	124.5982	131.6809	141.2609	149.5917 (72)
Total internal gains												
	431.3075	439.0884	422.1476	406.3095	386.8888	373.0909	359.7502	361.3619	371.7305	384.6486	407.5573	423.3024 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	7.7700	46.7521	0.7600	0.8000	0.7700	153.0589	(78)
Solar gains	153.0589	250.6711	319.3105	360.8901	376.0699	361.9161	353.6140	343.4082	333.5575	270.3723	181.4270	132.2570 (83)
Total gains	584.3664	689.7595	741.4581	767.1996	762.9587	735.0070	713.3642	704.7701	705.2880	655.0209	588.9843	555.5594 (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, ni1,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	166.6264	167.2933	167.9656	171.4097	172.1155	175.7337	175.7337	176.4757	174.2683	172.1155	170.7096	169.3265
alpha	12.1084	12.1529	12.1977	12.4273	12.4744	12.7156	12.7156	12.7650	12.6179	12.4744	12.3806	12.2884
util living area												
	0.9129	0.7848	0.6622	0.5244	0.4037	0.2825	0.2001	0.2108	0.3200	0.5258	0.7789	0.9327 (86)
MIT	20.9429	20.9890	20.9983	20.9999	21.0000	21.0000	21.0000	21.0000	21.0000	20.9999	20.9919	20.9285 (87)
Th 2	20.3770	20.3794	20.3817	20.3934	20.3958	20.4075	20.4075	20.4099	20.4028	20.3958	20.3911	20.3864 (88)
util rest of house												
	0.8927	0.7576	0.6345	0.4982	0.3775	0.2563	0.1731	0.1838	0.2923	0.4953	0.7478	0.9155 (89)
MIT 2	20.3343	20.3720	20.3807	20.3934	20.3958	20.4075	20.4075	20.4099	20.4028	20.3957	20.3860	20.3316 (90)
Living area fraction										fLA = Living area / (4) =		0.5451 (91)
MIT	20.6661	20.7083	20.7173	20.7240	20.7251	20.7305	20.7305	20.7316	20.7283	20.7251	20.7163	20.6569 (92)
Temperature adjustment												0.0000
adjusted MIT	20.6661	20.7083	20.7173	20.7240	20.7251	20.7305	20.7305	20.7316	20.7283	20.7251	20.7163	20.6569 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9024	0.7721	0.6496	0.5125	0.3918	0.2706	0.1878	0.1985	0.3074	0.5119	0.7646	0.9235	(94)
Useful gains	527.3587	532.5842	481.6196	393.1784	298.9128	198.8624	133.9858	139.9174	216.8200	335.3060	450.3420	513.0423	(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													
	559.9040	538.6663	482.5157	393.2258	298.9143	198.8624	133.9858	139.9174	216.8201	335.3446	454.6875	554.0353	(97)
Space heating kWh													
	24.2137	4.0872	0.6667	0.0341	0.0011	0.0000	0.0000	0.0000	0.0000	0.0287	3.1287	30.4987	(98a)
Space heating requirement - total per year (kWh/year)												62.6590	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	24.2137	4.0872	0.6667	0.0341	0.0011	0.0000	0.0000	0.0000	0.0000	0.0287	3.1287	30.4987	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												62.6590	
Space heating per m2											(98c) / (4) =	1.2073	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0500	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
	24.2137 4.0872 0.6667 0.0341 0.0011 0.0000 0.0000 0.0000 0.0000 0.0287 3.1287 30.4987	(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25		
307a	17.7335 2.9934 0.4883 0.0250 0.0008 0.0000 0.0000 0.0000 0.0000 0.0210 2.2914 22.3365	
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25		
307b	14.0470 2.3711 0.3868 0.0198 0.0007 0.0000 0.0000 0.0000 0.0000 0.0167 1.8151 17.6931	
Space heating requirement		

	31.7805	5.3644	0.8750	0.0448	0.0015	0.0000	0.0000	0.0000	0.0000	0.0377	4.1065	40.0296 (307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement												
	204.0968	180.8086	193.0943	172.4244	168.8778	154.0749	153.5555	158.6672	159.2885	175.3075	183.5241	202.2412 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25												
310a	149.4754	132.4197	141.4175	126.2793	123.6819	112.8406	112.4602	116.2039	116.6589	128.3908	134.4084	148.1164
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25												
310b	118.4016	104.8916	112.0189	100.0277	97.9702	89.3827	89.0814	92.0468	92.4073	101.7002	106.4669	117.3252
Water heating fuel												
	267.8770	237.3113	253.4363	226.3070	221.6521	202.2233	201.5416	208.2508	209.0662	230.0911	240.8753	265.4415 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	8.6567	7.8190	8.6567	8.3775	8.6567	8.3775	8.6567	8.6567	8.3775	8.6567	8.3775	8.6567 (331)
Lighting	14.5256	11.6530	10.4922	7.6871	5.9377	4.8512	5.4166	7.0407	9.1451	11.9989	13.5527	14.9293 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												82.2399 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2764.0736 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												0.8224 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5875)												
mechanical ventilation fans (SFP = 0.5875)												101.9262 (330a)
Total electricity for the above, kWh/year												101.9262 (331)
Electricity for lighting (calculated in Appendix L)												117.2302 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												3065.4699 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	91.9637	0.2100	19.3124	(363)
less credit emissions for electricity	-29.4284	0.3480	-10.2411	(364)
Water heating from Combined Heat and Power	3090.8879	0.2100	649.0865	(365)
less credit emissions for electricity	-989.0841	0.3480	-344.2013	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	1339.7983	0.2100	8.1294	(368)
Electrical energy for heat distribution (space & water)	0.8224	0.0000	4.0176	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			599.3317	(373)
Space and water heating			599.3317	(376)
Pumps, fans and electric keep-hot	101.9262	0.1387	14.1384	(378)
Energy for lighting	117.2302	0.1443	16.9199	(379)
Total CO2, kg/year			630.3901	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.1500	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	91.9637	1.1300	103.9190	(463)
less credit emissions for electricity	-29.4284	2.1490	-63.2416	(464)
Water heating from Combined Heat and Power	3090.8879	1.1300	3492.7034	(465)
less credit emissions for electricity	-989.0841	2.1490	-2125.5418	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	1339.7983	1.1300	43.7439	(468)
Electrical energy for heat distribution (space & water)	0.8224	0.0000	43.3185	(472)
Overall CO2 factor for heat network			1.0417	(486)

Total CO2 associated with community systems			2965.1296 (473)
Space and water heating			2965.1296 (476)
Pumps, fans and electric keep-hot	101.9262	1.5128	154.1939 (478)
Energy for lighting	117.2302	1.5338	179.8116 (479)
Total Primary energy kWh/year			3299.1350 (483)
Dwelling Primary energy Rate (DPER)			63.5700 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

			Area (m2)		Storey height (m)		Volume (m3)	
Ground floor			51.9000 (1b)	x	2.7400 (2b)	=	142.2060 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.9000							(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.2060 (5)	

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1406	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3906	(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) =	0.3027	(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													
	0.3860	0.3784	0.3709	0.3330	0.3255	0.2876	0.2876	0.2800	0.3027	0.3255	0.3406	0.3557	(22b)
Effective ac	0.5745	0.5716	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5458	0.5530	0.5580	0.5633	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			7.7700	1.1450	8.8969			(27)
External Wall 1	19.2348	7.7700	11.4648	0.1800	2.0637			(29a)
External Roof 1	51.9000		51.9000	0.1100	5.7090			(30)
Total net area of external elements Aum(A, m2)			71.1348					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		16.6696			(33)
Party Wall 1			58.5300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 395.4106 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	3.8400	0.0500	0.1920	
E3 Sill	1.5600	0.0500	0.0780	
E4 Jamb	7.7400	0.0500	0.3870	
E7 Party floor between dwellings (in blocks of flats)	7.0100	0.0700	0.4907	
E9 Balcony between dwellings, wall insulation continuous	7.0100	0.0200	0.1402	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	
E14 Flat roof	7.0100	0.0800	0.5608	
P4 Party wall - Roof (insulation at ceiling level)	21.3500	0.1200	2.5620	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.7395 (36)
Point Thermal bridges			(36a) =	0.0000

Total fabric heat loss (33) + (36) + (36a) = 21.4091 (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	26.9601	26.8243	26.6912	26.0662	25.9493	25.4049	25.4049	25.3041	25.6146	25.9493	26.1859	26.4332	(38)
Heat transfer coeff	48.3692	48.2334	48.1004	47.4753	47.3584	46.8140	46.8140	46.7132	47.0237	47.3584	47.5950	47.8423	(39)
Average = Sum(39)m / 12 =												47.4748	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9320	0.9294	0.9268	0.9147	0.9125	0.9020	0.9020	0.9001	0.9060	0.9125	0.9171	0.9218	(40)
HLP (average)												0.9147	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.7461	(42)
Hot water usage for mixer showers	53.4962	52.6923	51.5208	49.2793	47.6252	45.7805	44.7320	45.8946	47.1691	49.1497	51.4393	53.2912	(42a)
Hot water usage for baths	23.1283	22.7849	22.3012	21.4093	20.7415	20.0010	19.6010	20.0813	20.6043	21.3967	22.3069	23.0502	(42b)
Hot water usage for other uses	32.5120	31.3298	30.1475	28.9653	27.7830	26.6007	26.6007	27.7830	28.9653	30.1475	31.3298	32.5120	(42c)
Average daily hot water use (litres/day)												100.3217	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1366	106.8069	103.9694	99.6538	96.1496	92.3822	90.9337	93.7589	96.7386	100.6939	105.0759	108.8534	(44)
Energy conte	172.8457	152.0916	159.7971	136.4211	129.4359	113.5947	109.9764	116.0931	119.2884	136.6406	149.6999	170.4382	(45)
Energy content (annual)											Total = Sum(45)m =	1666.3227	
Distribution loss (46)m = 0.15 x (45)m	25.9268	22.8137	23.9696	20.4632	19.4154	17.0392	16.4965	17.4140	17.8933	20.4961	22.4550	25.5657	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	217.4857	192.4116	204.4371	179.6211	174.0759	156.7947	154.6164	160.7331	162.4884	181.2806	192.8999	215.0782	(62)
WWHRS	-24.4562	-21.6293	-22.6489	-18.7542	-17.4783	-14.9563	-14.0191	-14.9079	-15.4743	-18.2425	-20.6666	-24.0033	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	193.0294	170.7823	181.7882	160.8669	156.5976	141.8384	140.5973	145.8252	147.0140	163.0381	172.2334	191.0748	(64)
											Total per year (kWh/year) = Sum(64)m =	1964.6856	(64)
12Total per year (kWh/year)												1965	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	93.1832	82.8265	88.8445	79.9200	78.7494	72.3302	72.2792	74.3130	74.2234	81.1450	84.3352	92.3827	(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	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	81.1655	89.8619	81.1655	83.8711	81.1655	83.8711	81.1655	81.1655	83.8711	81.1655	83.8711	81.1655	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	152.1665	153.7456	149.7665	141.2955	130.6025	120.5525	113.8385	112.2595	116.2386	124.7095	135.4026	145.4526	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	(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)	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	(71)
Water heating gains (Table 5)	125.2462	123.2536	119.4147	111.0000	105.8460	100.4587	97.1494	99.8830	103.0880	109.0659	117.1323	124.1703	(72)
Total internal gains	407.7701	416.0529	399.5386	385.3585	366.8059	354.0741	341.3453	342.4999	352.3895	364.1328	385.5977	399.9802	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W

					W/m2	or Table 6b	or Table 6c		Table 6d				
South					7.7700	46.7521	0.6300	0.7000	0.7700			111.0181	(78)
Solar gains	111.0181	181.8190	231.6051	261.7641	272.7744	262.5082	256.4865	249.0839	241.9389	196.1088	131.5943	95.9298	(83)
Total gains	518.7882	597.8718	631.1437	647.1225	639.5802	616.5823	597.8318	591.5838	594.3284	560.2416	517.1920	495.9100	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	117.8540	118.1857	118.5127	120.0729	120.3694	121.7691	121.7691	122.0319	121.2262	120.3694	119.7711	119.1520	
alpha	8.8569	8.8790	8.9008	9.0049	9.0246	9.1179	9.1179	9.1355	9.0817	9.0246	8.9847	8.9435	
util living area	0.9928	0.9756	0.9378	0.8387	0.6810	0.4856	0.3445	0.3632	0.5449	0.8333	0.9739	0.9949	(86)
MIT	20.5743	20.7188	20.8463	20.9538	20.9929	20.9997	21.0000	21.0000	20.9991	20.9626	20.7699	20.5480	(87)
Th 2	20.1404	20.1426	20.1448	20.1550	20.1569	20.1658	20.1658	20.1674	20.1624	20.1569	20.1530	20.1490	(88)
util rest of house	0.9896	0.9658	0.9157	0.7956	0.6227	0.4225	0.2792	0.2975	0.4793	0.7822	0.9616	0.9925	(89)
MIT 2	19.6686	19.8480	19.9984	20.1186	20.1528	20.1657	20.1658	20.1674	20.1620	20.1300	19.9213	19.6428	(90)
Living area fraction									fLA = Living area / (4) =			0.5451	(91)
MIT	20.1623	20.3227	20.4606	20.5738	20.6107	20.6203	20.6205	20.6212	20.6183	20.5838	20.3839	20.1362	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1623	20.3227	20.4606	20.5738	20.6107	20.6203	20.6205	20.6212	20.6183	20.5838	20.3839	20.1362	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9681	0.9245	0.8178	0.6545	0.4569	0.3148	0.3333	0.5151	0.8091	0.9654	0.9924	(94)
Useful gains	513.4253	578.8096	583.5107	529.2043	418.5771	281.7124	188.2125	197.1823	306.1516	453.2953	499.2996	492.1567	(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	767.2448	743.8880	671.5091	554.2197	421.9977	281.8340	188.2159	197.1881	306.5150	472.8179	632.2448	762.4245	(97)
Space heating kWh	188.8417	110.9327	65.4708	18.0111	2.5449	0.0000	0.0000	0.0000	0.0000	14.5248	95.7206	201.0792	(98a)
Space heating requirement - total per year (kWh/year)												697.1258	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	188.8417	110.9327	65.4708	18.0111	2.5449	0.0000	0.0000	0.0000	0.0000	14.5248	95.7206	201.0792	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												697.1258	
Space heating per m2											(98c) / (4) =	13.4321	(99)

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 Combined Heat and Power-Space and Water												0.5580	(303a)
Fraction of heat from community Boilers-Space and Water												0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.2500	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement	188.8417	110.9327	65.4708	18.0111	2.5449	0.0000	0.0000	0.0000	0.0000	14.5248	95.7206	201.0792	(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25													
307a	131.7171	77.3755	45.6659	12.5628	1.7751	0.0000	0.0000	0.0000	0.0000	10.1310	66.7651	140.2528	
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25													
307b	104.3351	61.2903	36.1726	9.9511	1.4061	0.0000	0.0000	0.0000	0.0000	8.0249	52.8856	111.0963	
Space heating requirement	236.0522	138.6658	81.8385	22.5139	3.1811	0.0000	0.0000	0.0000	0.0000	18.1560	119.6507	251.3491	(307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement	193.0294	170.7823	181.7882	160.8669	156.5976	141.8384	140.5973	145.8252	147.0140	163.0381	172.2334	191.0748	(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25													
310a	134.6380	119.1207	126.7973	112.2047	109.2268	98.9323	98.0666	101.7131	102.5423	113.7191	120.1328	133.2747	
Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25													
310b	106.6488	94.3572	100.4380	88.8790	86.5202	78.3657	77.6800	80.5684	81.2253	90.0785	95.1589	105.5688	
Water heating fuel	241.2868	213.4779	227.2352	201.0836	195.7470	177.2980	175.7466	182.2815	183.7675	203.7976	215.2917	238.8435	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	16.8646	13.5294	12.1817	8.9249	6.8938	5.6323	6.2888	8.1744	10.6177	13.9310	15.7350	17.3333	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-5.3149	-8.2773	-13.1250	-16.3263	-19.0405	-18.3068	-18.0832	-16.3413	-13.5608	-10.1095	-6.1140	-4.5083	(333a)

Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-1.0177	-2.2370	-4.6351	-7.2537	-9.8909	-10.0537	-9.9380	-8.2757	-5.8869	-3.2923	-1.3871	-0.7980	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												871.4073	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												2455.8570	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												8.7141	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(331)
Electricity for lighting (calculated in Appendix L)												136.1070	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-213.7740	(333)
Wind generation												0.0000	(334)
Hydro-electric generation (Appendix N)												0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(335)
Appendix Q - special features													
Energy saved or generated												-0.0000	(336)
Energy used												0.0000	(337)
Total delivered energy for all uses												3249.5973	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	974.4394	0.2100	204.6323	(363)
less credit emissions for electricity	-311.8206	0.3480	-108.5136	(364)
Water heating from Combined Heat and Power	2746.2289	0.2100	576.7081	(365)
less credit emissions for electricity	-878.7932	0.3480	-305.8200	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	1566.1883	0.2100	86.1385	(368)
Electrical energy for heat distribution (space & water)	8.7141	0.0000	4.8395	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			700.7458	(373)
Space and water heating			700.7458	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	136.1070	0.1443	19.6444	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-149.1078	0.1326	-19.7685	
PV Unit electricity exported	-64.6661	0.1247	-8.0645	
Total			-27.8330	(380)
Total CO2, kg/year			692.5572	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			13.3400	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	974.4394	1.1300	1101.1166	(463)
less credit emissions for electricity	-311.8206	2.1490	-670.1025	(464)
Water heating from Combined Heat and Power	2746.2289	1.1300	3103.2386	(465)
less credit emissions for electricity	-878.7932	2.1490	-1888.5267	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	1566.1883	1.1300	463.5070	(468)
Electrical energy for heat distribution (space & water)	8.7141	0.0000	51.1726	(472)
Overall CO2 factor for heat network			1.0419	(486)
Total CO2 associated with community systems			3466.6914	(473)
Space and water heating			3466.6914	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	136.1070	1.5338	208.7654	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-149.1078	1.4899	-222.1514	
PV Unit electricity exported	-64.6661	0.4577	-29.5986	
Total			-251.7500	(480)
Total Primary energy kWh/year			3423.7068	(483)
Target Primary Energy Rate (TPER)			65.9700	(484)

Full SAP Calculation Printout

Property Reference	13, 07 x2_Copy_Copy	Issued on Date	12/09/2023
Assessment Reference	13, 07 x2_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	84 B	DER	3.18	TER	9.48
Environmental	97 A	% DER < TER			66.46
CO_2 Emissions (t/year)	0.46	DFEE	30.72	TFEE	37.91
Compliance Check	See BREL	% DFEE < TFEE			18.95
% DPER < TPER	32.57	DPER	33.39	TPER	49.52

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.1000 (1b)	x	2.7300 (2b)	=	166.8030 (1b)	-
First floor	62.1000 (1c)	x	2.9600 (2c)	=	183.8160 (1c)	-
Second floor	39.1000 (1d)	x	3.0200 (2d)	=	118.0820 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	162.3000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	468.7010	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	45.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4376	0.4344	0.4312	0.4153	0.4121	0.3961	0.3961	0.3929	0.4025	0.4121	0.4184	0.4248	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 0.80)			26.0900	0.7752	20.2248			(27)
front door					2.0000	1.0000	2.0000	(26)
Heatloss Floor 1					61.1000	0.0800	4.8880	110.0000	6721.0000	(28a)
exposed floor					1.6800	0.0800	0.1344			(28b)
External Wall 1	128.0622	28.0900			99.9722	0.1300	12.9964	190.0000	18994.7180	(29a)
External Roof 1	41.2700				41.2700	0.1000	4.1270	9.0000	371.4300	(30)
External Roof 2	19.2300				19.2300	0.1000	1.9230	9.0000	173.0700	(30)
Total net area of external elements Aum(A, m2)					251.3422					(31)
Fabric heat loss, W/K = Sum (A x U)						(26)...(30) + (32) =	46.2936			(33)
Party Wall 1					114.0000	0.0000	0.0000	180.0000	20520.0000	(32)
Internal Wall 1					330.5300			9.0000	2974.7700	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	49754.9880 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		306.5618 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	16.9600	0.0500	0.8480	
E3 Sill	15.7600	0.0500	0.7880	
E4 Jamb	40.5800	0.0500	2.0290	
E5 Ground floor (normal)	13.4000	0.1600	2.1440	
E6 Intermediate floor within a dwelling	13.4000	0.0010	0.0134	
E20 Exposed floor (normal)	1.8000	0.3200	0.5760	
E13 Gable (insulation at rafter level)	12.0000	0.0800	0.9600	
R5 Ridge (inverted)	6.5500	0.0400	0.2620	
P1 Party wall - Ground floor	20.4500	0.0800	1.6360	
P4 Party wall - Roof (insulation at ceiling level)	27.7000	0.1200	3.3240	
E14 Flat roof	9.2300	0.0800	0.7384	
P2 Party wall - Intermediate floor within a dwelling	21.0000	0.0000	0.0000	
R7 Flat ceiling (inverted)	5.6500	0.0400	0.2260	
E16 Corner (normal)	17.8800	0.0900	1.6092	
E18 Party wall between dwellings	36.6000	0.0600	2.1960	
R4 Ridge (vaulted ceiling)	6.5500	0.0800	0.5240	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.8740 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	64.1676 (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	67.6784	67.1854	66.6923	64.2273	63.7343	61.2692	61.2692	60.7762	62.2552	63.7343	64.7203	65.7063	(38)
Heat transfer coeff	131.8460	131.3530	130.8599	128.3949	127.9018	125.4368	125.4368	124.9438	126.4228	127.9018	128.8879	129.8739	(39)

Average = Sum(39)m / 12 = 128.2716

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8124	0.8093	0.8063	0.7911	0.7881	0.7729	0.7729	0.7698	0.7789	0.7881	0.7941	0.8002	(40)
HLP (average)												0.7903	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9521 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	101.3610	99.8377	97.6180	93.3710	90.2369	86.7417	84.7550	86.9579	89.3727	93.1255	97.4637	100.9726	(42a)
Hot water usage for baths	31.8240	31.3513	30.6858	29.4586	28.5397	27.5208	26.9704	27.6313	28.3509	29.4412	30.6937	31.7164	(42b)
Hot water usage for other uses	44.8626	43.2312	41.5998	39.9685	38.3371	36.7057	36.7057	38.3371	39.9685	41.5998	43.2312	44.8626	(42c)
Average daily hot water use (litres/day)												163.7414	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	178.0475	174.4202	169.9036	162.7981	157.1137	150.9682	148.4312	152.9264	157.6921	164.1665	171.3885	177.5516	(44)
Energy conte	281.9837	248.3721	261.1355	222.8625	211.5052	185.6331	179.5147	189.3548	194.4501	222.7724	244.1744	278.0028	(45)
Energy content (annual)											Total = Sum(45)m =	2719.7613	
Distribution loss (46)m = 0.15 x (45)m	42.2976	37.2558	39.1703	33.4294	31.7258	27.8450	26.9272	28.4032	29.1675	33.4159	36.6262	41.7004	(46)

Water storage loss:	
Store volume	180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5200 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	0.8208 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	25.4448	22.9824	25.4448	24.6240	25.4448	24.6240	25.4448	25.4448	24.6240	25.4448	24.6240	25.4448	(56)
If cylinder contains dedicated solar storage	25.4448	22.9824	25.4448	24.6240	25.4448	24.6240	25.4448	25.4448	24.6240	25.4448	24.6240	25.4448	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	330.6909	292.3657	309.8427	269.9985	260.2124	232.7691	228.2219	238.0620	241.5861	271.4796	291.3104	326.7100	(62)
WWHRS	-76.8882	-68.0006	-71.2063	-58.9616	-54.9501	-47.0212	-44.0749	-46.8692	-48.6500	-57.3529	-64.9739	-75.4644	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	253.8027	224.3651	238.6364	211.0369	205.2623	185.7479	184.1470	191.1928	192.9362	214.1267	226.3365	251.2456	(64)
											Total per year (kWh/year) = Sum(64)m =	2578.8360	(64)
12Total per year (kWh/year)												2579	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	132.7253	117.7786	125.7933	111.8106	109.2912	99.4318	98.6544	101.9262	102.3635	113.0376	118.8968	131.4017	(65)

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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	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	175.3892	194.1809	175.3892	181.2355	175.3892	181.2355	175.3892	175.3892	181.2355	175.3892	181.2355	175.3892	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	333.6109	337.0727	328.3490	309.7772	286.3337	264.3001	249.5803	246.1185	254.8422	273.4140	296.8575	318.8911	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	(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)

	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	(71)

Water heating gains (Table 5)

	178.3943	175.2658	169.0771	155.2925	146.8968	138.0997	132.6000	136.9976	142.1715	151.9322	165.1344	176.6152	(72)
Total internal gains													
	754.6760	773.8011	740.0969	713.5869	675.9014	650.9170	624.8512	625.7870	645.5309	668.0171	710.5091	738.1771	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.9200	10.6334	0.5000	0.8000	0.7700	32.1875	(74)
South	11.5200	46.7521	0.5000	0.8000	0.7700	149.2954	(78)
Southwest	3.6500	36.7938	0.5000	0.8000	0.7700	37.2273	(79)

Solar gains	218.7102	369.4313	502.7459	627.4120	713.4018	714.6767	686.2182	619.9246	544.9732	407.0298	261.2631	187.6969	(83)
Total gains	973.3863	1143.2323	1242.8428	1340.9989	1389.3032	1365.5937	1311.0694	1245.7116	1190.5041	1075.0469	971.7722	925.8740	(84)

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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, n1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	104.8256	105.2190	105.6154	107.6432	108.0581	110.1816	110.1816	110.6164	109.3223	108.0581	107.2314	106.4173	
alpha	7.9884	8.0146	8.0410	8.1762	8.2039	8.3454	8.3454	8.3744	8.2882	8.2039	8.1488	8.0945	
util living area													
	0.9992	0.9967	0.9883	0.9445	0.8109	0.5850	0.4208	0.4610	0.7170	0.9611	0.9969	0.9994	(86)
Living	20.2734	20.4232	20.6040	20.8298	20.9627	20.9976	20.9999	20.9997	20.9889	20.8238	20.5122	20.2558	
Non living	19.5749	19.7262	19.9067	20.1313	20.2417	20.2760	20.2769	20.2795	20.2667	20.1316	19.8264	19.5663	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.6283	20.4232	20.6040	20.8298	20.9627	20.9976	20.9999	20.9997	20.9889	20.8238	20.5122	20.3599	(87)
Th 2	20.2426	20.2453	20.2479	20.2611	20.2637	20.2769	20.2769	20.2796	20.2716	20.2637	20.2584	20.2532	(88)
util rest of house													
	0.9989	0.9954	0.9836	0.9246	0.7617	0.5204	0.3518	0.3890	0.6484	0.9427	0.9954	0.9992	(89)
MIT 2	19.9010	19.7262	19.9067	20.1313	20.2417	20.2760	20.2769	20.2795	20.2667	20.1316	19.8264	19.6623	(90)
Living area fraction										fLA = Living area / (4) =		0.1348	(91)
MIT	19.9991	19.8201	20.0007	20.2254	20.3389	20.3733	20.3743	20.3766	20.3641	20.2249	19.9189	19.7564	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9991	19.8201	20.0007	20.2254	20.3389	20.3733	20.3743	20.3766	20.3641	20.2249	19.9189	19.7564	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9987	0.9944	0.9817	0.9235	0.7670	0.5291	0.3611	0.3987	0.6574	0.9415	0.9945	0.9990	(94)
Useful gains	972.1406	1136.8460	1220.1093	1238.4008	1065.5990	722.4712	473.3802	496.7139	782.6726	1012.1515	966.4338	924.9670	(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													
	2069.8586	1959.8050	1766.7063	1454.1275	1104.9267	724.1847	473.4417	496.8495	791.9199	1231.0434	1652.1965	2020.3674	(97)
Space heating kWh													
	816.7022	553.0285	406.6682	155.3232	29.2598	0.0000	0.0000	0.0000	0.0000	162.8556	493.7491	814.9779	(98a)
Space heating requirement - total per year (kWh/year)												3432.5645	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	816.7022	553.0285	406.6682	155.3232	29.2598	0.0000	0.0000	0.0000	0.0000	162.8556	493.7491	814.9779	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3432.5645	
Space heating per m2											(98c) / (4) =	21.1495	(99)

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 %)	248.8827	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	816.7022	553.0285	406.6682	155.3232	29.2598	0.0000	0.0000	0.0000	0.0000	162.8556	493.7491	814.9779	(98)
Space heating efficiency (main heating system 1)													
	248.8827	248.8827	248.8827	248.8827	248.8827	0.0000	0.0000	0.0000	0.0000	248.8827	248.8827	248.8827	(210)
Space heating fuel (main heating system)													
	328.1475	222.2045	163.3976	62.4082	11.7565	0.0000	0.0000	0.0000	0.0000	65.4347	198.3863	327.4547	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	253.8027	224.3651	238.6364	211.0369	205.2623	185.7479	184.1470	191.1928	192.9362	214.1267	226.3365	251.2456	(64)
Efficiency of water heater												177.3050	(216)
(217)m	177.3050	177.3050	177.3050	177.3050	177.3050	177.3050	177.3050	177.3050	177.3050	177.3050	177.3050	177.3050	(217)
Fuel for water heating, kWh/month													
	143.1447	126.5419	134.5909	119.0247	115.7679	104.7618	103.8589	107.8327	108.8160	120.7674	127.6537	141.7025	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	35.2097	31.8023	35.2097	34.0739	35.2097	34.0739	35.2097	35.2097	34.0739	35.2097	34.0739	35.2097	(231)
Lighting	32.2215	25.8493	23.2744	17.0518	13.1713	10.7611	12.0153	15.6180	20.2862	26.6166	30.0634	33.1170	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	1379.1900	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	177.3050	
Water heating fuel used	1454.4630	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7250)		
mechanical ventilation fans (SFP = 0.7250)	414.5660	(230a)
Total electricity for the above, kWh/year	414.5660	(231)
Electricity for lighting (calculated in Appendix L)	260.0461	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3508.2650	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1379.1900	0.1572	216.7474	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1454.4630	0.1408	204.7237	(264)
Space and water heating			421.4711	(265)
Pumps, fans and electric keep-hot	414.5660	0.1387	57.5054	(267)
Energy for lighting	260.0461	0.1443	37.5327	(268)
Total CO2, kg/year			516.5092	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.1800	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy	Primary energy factor	Primary energy	

	kWh/year	kg CO2/kWh	kWh/year	
Space heating - main system 1	1379.1900	1.5818	2181.5749	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1454.4630	1.5205	2211.4463	(278)
Space and water heating			4393.0211	(279)
Pumps, fans and electric keep-hot	414.5660	1.5128	627.1555	(281)
Energy for lighting	260.0461	1.5338	398.8673	(282)
Total Primary energy kWh/year			5419.0440	(286)
Dwelling Primary energy Rate (DPER)			33.3900	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.1000 (1b)	x	2.7300 (2b)	=	166.8030 (1b)	-
First floor	62.1000 (1c)	x	2.9600 (2c)	=	183.8160 (1c)	-
Second floor	39.1000 (1d)	x	3.0200 (2d)	=	118.0820 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	162.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	468.7010	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0853	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3353	(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) =	0.2850	(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													
	0.3634	0.3563	0.3492	0.3135	0.3064	0.2708	0.2708	0.2637	0.2850	0.3064	0.3207	0.3349	(22b)
Effective ac	0.5660	0.5635	0.5610	0.5492	0.5469	0.5367	0.5367	0.5348	0.5406	0.5469	0.5514	0.5561	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.20)			26.0900	1.1450	29.8740			(27)
Heatloss Floor 1			61.1000	0.1300	7.9430			(28a)
exposed floor			1.6800	0.1300	0.2184			(28b)
External Wall 1	128.0622	28.0900	99.9722	0.1800	17.9950			(29a)
External Roof 1	41.2700		41.2700	0.1100	4.5397			(30)
External Roof 2	19.2300		19.2300	0.1100	2.1153			(30)
Total net area of external elements Aum(A, m2)			251.3422					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.6854			(33)
Party Wall 1			114.0000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							306.5618	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	16.9600	0.0500	0.8480
E3 Sill	15.7600	0.0500	0.7880
E4 Jamb	40.5800	0.0500	2.0290
E5 Ground floor (normal)	13.4000	0.1600	2.1440
E6 Intermediate floor within a dwelling	13.4000	0.0000	0.0000
E20 Exposed floor (normal)	1.8000	0.3200	0.5760
E13 Gable (insulation at rafter level)	12.0000	0.0800	0.9600
R5 Ridge (inverted)	6.5500	0.0400	0.2620
P1 Party wall - Ground floor	20.4500	0.0800	1.6360
P4 Party wall - Roof (insulation at ceiling level)	27.7000	0.1200	3.3240
E14 Flat roof	9.2300	0.0800	0.7384
P2 Party wall - Intermediate floor within a dwelling	21.0000	0.0000	0.0000
R7 Flat ceiling (inverted)	5.6500	0.0400	0.2260
E16 Corner (normal)	17.8800	0.0900	1.6092
E18 Party wall between dwellings	36.6000	0.0600	2.1960
R4 Ridge (vaulted ceiling)	6.5500	0.0800	0.5240

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 17.8606 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 82.5460 (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	87.5501	87.1535	86.7647	84.9386	84.5969	83.0064	83.0064	82.7119	83.6191	84.5969	85.2881	86.0107	(38)
Heat transfer coeff	170.0961	169.6995	169.3107	167.4846	167.1430	165.5525	165.5525	165.2579	166.1651	167.1430	167.8341	168.5567	(39)
Average = Sum(39)m / 12 =												167.4830	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0480	1.0456	1.0432	1.0319	1.0298	1.0200	1.0200	1.0182	1.0238	1.0298	1.0341	1.0386	(40)
HLP (average)												1.0319	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9521 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	73.7171	72.6092	70.9949	67.9062	65.6268	63.0849	61.6400	63.2421	64.9983	67.7276	70.8827	73.4346	(42a)
Hot water usage for baths	31.8240	31.3513	30.6858	29.4586	28.5397	27.5208	26.9704	27.6313	28.3509	29.4412	30.6937	31.7164	(42b)
Hot water usage for other uses	44.8626	43.2312	41.5998	39.9685	38.3371	36.7057	36.7057	38.3371	39.9685	41.5998	43.2312	44.8626	(42c)
Average daily hot water use (litres/day)												138.2546	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	150.4036	147.1918	143.2805	137.3333	132.5036	127.3114	125.3162	129.2106	133.3177	138.7687	144.8075	150.0136	(44)
Energy conte	238.2025	209.5991	220.2168	188.0024	178.3754	156.5442	151.5591	159.9897	164.3941	188.3078	206.3049	234.8850	(45)
Energy content (annual)											Total = Sum(45)m =	2296.3810	
Distribution loss (46)m = 0.15 x (45)m	35.7304	31.4399	33.0325	28.2004	26.7563	23.4816	22.7339	23.9985	24.6591	28.2462	30.9457	35.2328	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	287.4452	254.0764	269.4595	235.6566	227.6180	204.1984	200.8018	209.2323	212.0483	237.5504	253.9591	284.1277	(62)
WWHRS	-33.7004	-29.8049	-31.2099	-25.8431	-24.0848	-20.6095	-19.3182	-20.5429	-21.3234	-25.1380	-28.4783	-33.0763	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	253.7448	224.2715	238.2496	209.8135	203.5332	183.5889	181.4836	188.6894	190.7249	212.4125	225.4808	251.0514	(64)
										Total per year (kWh/year) = Sum(64)m =		2563.0441	(64)
12Total per year (kWh/year)												2563	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	118.5965	105.2735	112.6162	100.6342	98.7039	90.1743	89.7875	92.5907	92.7844	102.0065	106.7197	117.4934	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	147.6056	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	175.3892	194.1809	175.3892	181.2355	175.3892	181.2355	175.3892	175.3892	181.2355	175.3892	181.2355	175.3892	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	333.6109	337.0727	328.3490	309.7772	286.3337	264.3001	249.5803	246.1185	254.8422	273.4140	296.8575	318.8911	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	37.7606	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)												
	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	-118.0845	(71)
Water heating gains (Table 5)												
	159.4039	156.6570	151.3659	139.7697	132.6666	125.2421	120.6822	124.4499	128.8672	137.1055	148.2218	157.9212 (72)
Total internal gains												
	738.6856	758.1923	725.3858	701.0641	664.6712	638.0594	612.9334	613.2392	632.2266	656.1903	696.5965	722.4832 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.9200	10.6334	0.6300	0.7000	0.7700	35.4868	(74)
South	11.5200	46.7521	0.6300	0.7000	0.7700	164.5982	(78)
Southwest	3.6500	36.7938	0.6300	0.7000	0.7700	41.0431	(79)

Solar gains	241.1280	407.2980	554.2773	691.7217	786.5255	787.9311	756.5555	683.4669	600.8330	448.7503	288.0426	206.9358	(83)
Total gains	979.8136	1165.4903	1279.6631	1392.7858	1451.1967	1425.9905	1369.4889	1296.7061	1233.0596	1104.9407	984.6391	929.4190	(84)

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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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	81.2530	81.4430	81.6300	82.5200	82.6887	83.4831	83.4831	83.6319	83.1753	82.6887	82.3482	81.9951	
alpha	6.4169	6.4295	6.4420	6.5013	6.5126	6.5655	6.5655	6.5755	6.5450	6.5126	6.4899	6.4663	
util living area													
	0.9993	0.9976	0.9927	0.9710	0.8947	0.7126	0.5279	0.5789	0.8339	0.9803	0.9979	0.9995	(86)
MIT	19.9404	20.1062	20.3251	20.6152	20.8539	20.9752	20.9969	20.9945	20.9324	20.6260	20.2296	19.9152	(87)
Th 2	20.0435	20.0455	20.0475	20.0568	20.0585	20.0667	20.0667	20.0682	20.0635	20.0585	20.0550	20.0513	(88)
util rest of house													
	0.9990	0.9966	0.9896	0.9576	0.8499	0.6226	0.4183	0.4658	0.7569	0.9687	0.9968	0.9993	(89)
MIT 2	18.8024	19.0162	19.2964	19.6652	19.9386	20.0540	20.0659	20.0666	20.0213	19.6845	19.1818	18.7762	(90)
Living area fraction									fLA = Living area / (4) =			0.1348	(91)
MIT	18.9558	19.1631	19.4351	19.7932	20.0620	20.1782	20.1914	20.1917	20.1441	19.8114	19.3231	18.9298	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9558	19.1631	19.4351	19.7932	20.0620	20.1782	20.1914	20.1917	20.1441	19.8114	19.3231	18.9298	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9985	0.9953	0.9867	0.9529	0.8500	0.6339	0.4331	0.4811	0.7644	0.9645	0.9955	0.9989	(94)
Useful gains	978.3267	1159.9631	1262.6569	1327.1564	1233.5789	903.9785	593.1522	623.8800	942.5467	1065.7403	980.2516	928.4064	(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													
	2492.8985	2420.4458	2190.0549	1824.4510	1397.6437	923.4841	594.5601	626.6040	1004.3235	1539.6251	2051.4488	2482.7991	(97)
Space heating kWh													
	1126.8414	847.0444	689.9841	358.0521	122.0642	0.0000	0.0000	0.0000	0.0000	352.5703	771.2620	1156.4682	(98a)
Space heating requirement - total per year (kWh/year)												5424.2866	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1126.8414	847.0444	689.9841	358.0521	122.0642	0.0000	0.0000	0.0000	0.0000	352.5703	771.2620	1156.4682	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5424.2866	
Space heating per m2											(98c) / (4) =	33.4214	(99)

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 %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1126.8414	847.0444	689.9841	358.0521	122.0642	0.0000	0.0000	0.0000	0.0000	352.5703	771.2620	1156.4682	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	1220.8466	917.7079	747.5451	387.9221	132.2473	0.0000	0.0000	0.0000	0.0000	381.9830	835.6034	1252.9449	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	253.7448	224.2715	238.2496	209.8135	203.5332	183.5889	181.4836	188.6894	190.7249	212.4125	225.4808	251.0514	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.9967	86.7518	86.3018	85.2477	82.9518	79.8000	79.8000	79.8000	79.8000	85.1879	86.5908	87.0489	(217)
Fuel for water heating, kWh/month													
	291.6719	258.5209	276.0657	246.1222	245.3631	230.0613	227.4230	236.4529	239.0036	249.3459	260.3981	288.4027	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	36.4424	29.2355	26.3233	19.2856	14.8967	12.1708	13.5893	17.6639	22.9436	30.1033	34.0016	37.4553	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-56.5382	-79.3842	-113.6034	-127.0728	-136.3602	-126.9068	-125.2088	-118.4602	-106.5571	-90.3389	-61.9913	-48.9078	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-32.9242	-69.1527	-137.2971	-206.0462	-272.3588	-273.7462	-270.6513	-229.3076	-168.1842	-98.9902	-43.9778	-26.0546	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												5876.8002	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3048.8314	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												294.1111	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3020.0206	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												6285.7222	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5876.8002	0.2100	1234.1280	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3048.8314	0.2100	640.2546	(264)
Space and water heating			1874.3826	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	294.1111	0.1443	42.4493	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1191.3297	0.1347	-160.4827	
PV Unit electricity exported	-1828.6909	0.1259	-230.2470	
Total			-390.7298	(269)
Total CO2, kg/year			1538.0315	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			9.4800	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5876.8002	1.1300	6640.7843	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3048.8314	1.1300	3445.1795	(278)
Space and water heating			10085.9638	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	294.1111	1.5338	451.1175	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1191.3297	1.4979	-1784.4552	
PV Unit electricity exported	-1828.6909	0.4622	-845.1641	
Total			-2629.6193	(283)
Total Primary energy kWh/year			8037.5627	(286)
Target Primary Energy Rate (TPER)			49.5200	(287)

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Property Reference	BH1 L01-6 02 x6_Copy	Issued on Date	12/09/2023
Assessment Reference	BH1 L01 02_Copy	Prop Type Ref	
Property			

SAP Rating	89 B	DER	9.84	TER	11.27
Environmental	91 B	% DER < TER			12.69
CO_2 Emissions (t/year)	0.85	DFEE	27.71	TFEE	27.09
Compliance Check	See BREL	% DFEE < TFEE			-2.27
% DPER < TPER	9.03	DPER	49.78	TPER	54.72

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	99.7000 (1b)	x	2.7400 (2b)	=	273.1780 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	99.7000				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		273.1780 (5)	

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.8000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2986	0.2954	0.2922	0.2762	0.2731	0.2571	0.2571	0.2539	0.2635	0.2731	0.2794	0.2858	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.30)			20.4500	1.2357	25.2709			(27)
External Wall 1	66.4998	20.4500	46.0498	0.1400	6.4470	190.0000	8749.4620	(29a)
Total net area of external elements Aum(A, m2)			66.4998					(31)

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Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	31.7179	(33)
Party Wall 1	66.4700	0.0000	0.0000	180.0000	11964.6000 (32)
Party Floor 1	99.7000			40.0000	3988.0000 (32d)
Party Ceiling 1	99.7000			30.0000	2991.0000 (32b)
Internal Wall 1	176.5300			75.0000	13239.7500 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =		40932.8120 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					410.5598 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	11.4100	0.0300	0.3423	
E3 Sill	7.9000	0.0300	0.2370	
E4 Jamb	24.9000	0.0300	0.7470	
E7 Party floor between dwellings (in blocks of flats)	48.5400	0.0700	3.3978	
E8 Balcony within a dwelling, wall insulation continuous	6.6000	0.0000	0.0000	
E16 Corner (normal)	5.4800	0.0900	0.4932	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	
E17 Corner (inverted - internal area greater than external area)	2.7400	0.0000	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		5.5461	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	37.2640	(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	26.9150	26.6277	26.3403	24.9036	24.6162	23.1795	23.1795	22.8921	23.7542	24.6162	25.1909	25.7656	(38)
Heat transfer coeff	64.1790	63.8917	63.6043	62.1676	61.8802	60.4435	60.4435	60.1561	61.0182	61.8802	62.4549	63.0296	(39)
Average = Sum(39)m / 12 =												62.0957	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6437	0.6408	0.6380	0.6235	0.6207	0.6063	0.6063	0.6034	0.6120	0.6207	0.6264	0.6322	(40)
HLP (average)												0.6228	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7367	(42)
Hot water usage for mixer showers	96.3954	94.9468	92.8359	88.7969	85.8163	82.4924	80.6030	82.6980	84.9945	88.5634	92.6891	96.0261	(42a)
Hot water usage for baths	31.8642	31.3910	30.7246	29.4958	28.5758	27.5556	27.0045	27.6663	28.3868	29.4784	30.7325	31.7565	(42b)
Hot water usage for other uses	44.9020	43.2692	41.6364	40.0036	38.3708	36.7380	36.7380	38.3708	40.0036	41.6364	43.2692	44.9020	(42c)
Average daily hot water use (litres/day)												159.2365	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	173.1616	169.6069	165.1968	158.2964	152.7629	146.7859	144.3455	148.7350	153.3848	159.6782	166.6907	172.6846	(44)
Energy conte	274.2457	241.5180	253.9013	216.6998	205.6482	180.4904	174.5734	184.1650	189.1388	216.6818	237.4815	270.3823	(45)
Energy content (annual)										Total = Sum(45)m =		2644.9263	
Distribution loss (46)m = 0.15 x (45)m	41.1368	36.2277	38.0852	32.5050	30.8472	27.0736	26.1860	27.6248	28.3708	32.5023	35.6222	40.5573	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	329.5225	291.4455	309.1781	270.1935	260.9250	233.9841	229.8502	239.4418	242.6325	271.9586	290.9751	325.6591	(62)
WWHRS	-73.1216	-64.6693	-67.7180	-56.0732	-52.2582	-44.7177	-41.9157	-44.5732	-46.2667	-54.5433	-61.7909	-71.7675	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	256.4009	226.7761	241.4601	214.1203	208.6668	189.2664	187.9345	194.8687	196.3658	217.4153	229.1842	253.8916	(64)
									Total per year (kWh/year) = Sum(64)m =			2616.3507	(64)
12Total per year (kWh/year)												2616	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	135.4081	120.2467	128.6436	114.8476	112.5995	102.8080	102.2671	105.4563	105.6836	116.2681	121.7575	134.1236	(65)

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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	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	129.0428	142.8689	129.0428	133.3443	129.0428	133.3443	129.0428	129.0428	133.3443	129.0428	133.3443	129.0428	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
255.8419 258.4967 251.8066 237.5642 219.5856 202.6883 191.3999 188.7451 195.4352 209.6776 227.6562 244.5534 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
36.6837 36.6837 36.6837 36.6837 36.6837 36.6837 36.6837 36.6837 36.6837 36.6837 36.6837 36.6837 (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)
-109.4693 -109.4693 -109.4693 -109.4693 -109.4693 -109.4693 -109.4693 -109.4693 -109.4693 -109.4693 -109.4693 -109.4693 (71)
Water heating gains (Table 5)
182.0002 178.9385 172.9081 159.5106 151.3434 142.7889 137.4558 141.7424 146.7828 156.2744 169.1077 180.2736 (72)
Total internal gains
630.9358 644.3551 617.8085 594.4700 564.0228 542.8725 521.9495 523.5813 539.6132 559.0458 594.1591 617.9208 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.3500	10.6334	0.3300	0.8000	0.7700	10.4079	(74)
East	15.1000	19.6403	0.3300	0.8000	0.7700	54.2577	(76)

Solar gains	64.6656	126.0296	208.5948	309.2189	385.5583	398.1139	377.5791	319.5391	243.9320	149.6200	80.4925	53.2954	(83)
Total gains	695.6014	770.3847	826.4033	903.6889	949.5812	940.9864	899.5286	843.1203	783.5452	708.6658	674.6515	671.2163	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	177.1642	177.9610	178.7650	182.8964	183.7457	188.1134	188.1134	189.0119	186.3416	183.7457	182.0549	180.3950	
alpha	12.8109	12.8641	12.9177	13.1931	13.2497	13.5409	13.5409	13.6008	13.4228	13.2497	13.1370	13.0263	
util living area	0.9986	0.9938	0.9678	0.8190	0.6057	0.4111	0.2957	0.3282	0.5373	0.8770	0.9916	0.9990	(86)
MIT	20.7135	20.8001	20.9069	20.9908	20.9998	21.0000	21.0000	21.0000	21.0000	20.9832	20.8484	20.7046	(87)
Th 2	20.3908	20.3934	20.3960	20.4089	20.4114	20.4244	20.4244	20.4270	20.4192	20.4114	20.4063	20.4011	(88)
util rest of house	0.9979	0.9909	0.9551	0.7839	0.5676	0.3741	0.2570	0.2873	0.4921	0.8389	0.9872	0.9985	(89)
MIT 2	20.1337	20.2213	20.3241	20.4034	20.4113	20.4244	20.4244	20.4270	20.4192	20.4018	20.2806	20.1342	(90)
Living area fraction									fLA = Living area / (4) =			0.2152	(91)
MIT	20.2585	20.3459	20.4495	20.5299	20.5380	20.5483	20.5483	20.5503	20.5442	20.5270	20.4028	20.2570	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.2585	20.3459	20.4495	20.5299	20.5380	20.5483	20.5483	20.5503	20.5442	20.5270	20.4028	20.2570	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9906	0.9564	0.7913	0.5758	0.3821	0.2653	0.2961	0.5018	0.8468	0.9871	0.9984	(94)
Useful gains	694.0232	763.1636	790.3551	715.0463	546.7422	359.5340	238.6475	249.6666	393.1943	600.1224	665.9682	670.1388	(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	1024.1993	986.8614	887.2510	723.0007	546.8973	359.5345	238.6475	249.6666	393.2131	614.2830	830.8277	1012.0636	(97)
Space heating kWh	245.6510	150.3250	72.0905	5.7272	0.1154	0.0000	0.0000	0.0000	0.0000	10.5355	118.6988	254.3920	(98a)
Space heating requirement - total per year (kWh/year)												857.5354	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	245.6510	150.3250	72.0905	5.7272	0.1154	0.0000	0.0000	0.0000	0.0000	10.5355	118.6988	254.3920	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												857.5354	
Space heating per m2											(98c) / (4) =	8.6012	(99)

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 Combined Heat and Power-Space and Water 0.5580 (303a)
Fraction of heat from community Boilers-Space and Water 0.4420 (303b)
Factor for control and charging method (Table 4c(3)) for space heating 1.0500 (305)
Factor for charging method (Table 4c(3)) for water heating 1.0500 (305a)
Distribution loss factor (Table 12c) for community heating system 1.2500 (306)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating:
Space heating requirement
245.6510 150.3250 72.0905 5.7272 0.1154 0.0000 0.0000 0.0000 0.0000 10.5355 118.6988 254.3920 (98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25
307a 179.9087 110.0942 52.7973 4.1945 0.0845 0.0000 0.0000 0.0000 0.0000 7.7159 86.9321 186.3104
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25
307b 142.5083 87.2073 41.8215 3.3225 0.0669 0.0000 0.0000 0.0000 0.0000 6.1119 68.8602 147.5792

Space heating requirement
322.4169 197.3015 94.6188 7.5170 0.1514 0.0000 0.0000 0.0000 0.0000 13.8278 155.7922 333.8895 (307)
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 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (309)

Water heating
Annual water heating requirement
256.4009 226.7761 241.4601 214.1203 208.6668 189.2664 187.9345 194.8687 196.3658 217.4153 229.1842 253.8916 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25
310a 187.7816 166.0852 176.8394 156.8163 152.8223 138.6140 137.6385 142.7169 143.8134 159.2295 167.8488 185.9439
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25
310b 148.7446 131.5585 140.0771 124.2165 121.0528 109.7982 109.0255 113.0482 113.9167 126.1281 132.9555 147.2889
Water heating fuel
336.5261 297.6437 316.9164 281.0329 273.8752 248.4121 246.6640 255.7651 257.7302 285.3576 300.8043 333.2327 (310)
Cooling System Energy Efficiency Ratio 0.0000 (314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (315)
Pumps and Fa 16.6296 15.0203 16.6296 16.0932 16.6296 16.0932 16.6296 16.6296 16.0932 16.6296 16.0932 16.6296 (331)
Lighting 23.7070 19.0187 17.1242 12.5459 9.6908 7.9175 8.8403 11.4909 14.9256 19.5832 22.1192 24.3659 (332)
Electricity generated by PVs (Appendix M) (negative quantity)
(333a)m -8.8455 -13.8495 -22.1373 -27.7786 -32.6053 -31.4419 -31.0318 -27.9065 -22.9726 -16.9728 -10.1931 -7.4930 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(334a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(335a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)
(333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (335b)
Annual totals kWh/year
Space heating fuel - community heating 1125.5152 (307)
Space heating fuel - secondary 0.0000 (309)
Water heating fuel - community heating 3433.9603 (310)
Efficiency of water heater 0.0000 (311)
Electricity used for heat distribution 11.2552 (313)
Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5875)
mechanical ventilation fans (SFP = 0.5875) 195.8003 (330a)
Total electricity for the above, kWh/year 195.8003 (331)
Electricity for lighting (calculated in Appendix L) 191.3292 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -253.2279 (333)
Wind generation 0.0000 (334)
Hydro-electric generation (Appendix N) 0.0000 (335a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (335)
Appendix Q - special features
Energy saved or generated -0.0000 (336)
Energy used 0.0000 (337)
Total delivered energy for all uses 4693.3772 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	1258.5921	0.2100	264.3043	(363)
less credit emissions for electricity	-402.7495	0.3480	-140.1568	(364)
Water heating from Combined Heat and Power	3839.9796	0.2100	806.3957	(365)
less credit emissions for electricity	-1228.7935	0.3480	-427.6201	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2146.2068	0.2100	111.2570	(368)
Electrical energy for heat distribution (space & water)	11.2552	0.0000	6.6265	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			960.2531	(373)
Space and water heating			960.2531	(376)
Pumps, fans and electric keep-hot	195.8003	0.1387	27.1599	(378)
Energy for lighting	191.3292	0.1443	27.6147	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-253.2279	0.1324	-33.5355	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-33.5355	(380)
Total CO2, kg/year			981.4922	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.8400	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	1258.5921	1.1300	1422.2091	(463)
less credit emissions for electricity	-402.7495	2.1490	-865.5086	(464)

Water heating from Combined Heat and Power	3839.9796	1.1300	4339.1770 (465)
less credit emissions for electricity	-1228.7935	2.1490	-2640.6772 (466)
Efficiency of heat source Boilers			93.9000 (467b)
Space and Water heating from Boilers	2146.2068	1.1300	598.6686 (468)
Electrical energy for heat distribution (space & water)	11.2552	0.0000	70.1034 (472)
Overall CO2 factor for heat network			1.0419 (486)
Total CO2 associated with community systems			4750.5173 (473)
Space and water heating			4750.5173 (476)
Pumps, fans and electric keep-hot	195.8003	1.5128	296.2067 (478)
Energy for lighting	191.3292	1.5338	293.4672 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-253.2279	1.4893	-377.1378
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-377.1378 (480)
Total Primary energy kWh/year			4963.0534 (483)
Dwelling Primary energy Rate (DPER)			49.7800 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		99.7000 (1b)	x	2.7400 (2b)	=	273.1780 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	99.7000					
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	273.1780 (5)

2. Ventilation rate

			m3 per hour
Number of open chimneys		0 * 80 =	0.0000 (6a)
Number of open flues		0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000 (6d)
Number of flues attached to other heater		0 * 35 =	0.0000 (6e)
Number of blocked chimneys		0 * 20 =	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1098 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3598 (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) =	0.3058 (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	0.3900	0.3823	0.3747	0.3364	0.3288	0.2906	0.2906	0.2829	0.3058	0.3288	0.3441	0.3594	(22b)
Effective ac	0.5760	0.5731	0.5702	0.5566	0.5540	0.5422	0.5422	0.5400	0.5468	0.5540	0.5592	0.5646	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			20.4500	1.1450	23.4160			(27)
External Wall 1	66.4998	20.4500	46.0498	0.1800	8.2890			(29a)
Total net area of external elements Aum(A, m2)			66.4998					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.7050			(33)
Party Wall 1			66.4700	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 420.5598 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	11.4100	0.0500	0.5705
E3 Sill	7.9000	0.0500	0.3950
E4 Jamb	24.9000	0.0500	1.2450
E7 Party floor between dwellings (in blocks of flats)	48.5400	0.0700	3.3978
E8 Balcony within a dwelling, wall insulation continuous	6.6000	0.0000	0.0000
E16 Corner (normal)	5.4800	0.0900	0.4932
E18 Party wall between dwellings	5.4800	0.0600	0.3288
E17 Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			6.1837 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	37.8887 (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	51.9285	51.6624	51.4015	50.1761	49.9469	48.8796	48.8796	48.6820	49.2907	49.9469	50.4107	50.8955	(38)
Heat transfer coeff	89.8172	89.5511	89.2902	88.0648	87.8356	86.7683	86.7683	86.5707	87.1794	87.8356	88.2994	88.7842	(39)
Average = Sum(39)m / 12 =												88.0637	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9009	0.8982	0.8956	0.8833	0.8810	0.8703	0.8703	0.8683	0.8744	0.8810	0.8857	0.8905	(40)
HLP (average)												0.8833	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7367 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	70.1058	69.0522	67.5170	64.5796	62.4119	59.9944	58.6204	60.1440	61.8142	64.4097	67.4102	69.8372	(42a)
Hot water usage for baths	30.2710	29.8214	29.1883	28.0211	27.1470	26.1778	25.6543	26.2830	26.9674	28.0045	29.1958	30.1687	(42b)
Hot water usage for other uses	42.6569	41.1057	39.5545	38.0034	36.4522	34.9011	34.9011	36.4522	38.0034	39.5545	41.1057	42.6569	(42c)
Average daily hot water use (litres/day)												131.4801	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	143.0336	139.9794	136.2599	130.6040	126.0111	121.0733	119.1758	122.8792	126.7850	131.9688	137.7118	142.6627	(44)
Energy conte	226.5303	199.3287	209.4264	178.7904	169.6352	148.8738	144.1327	152.1501	156.3386	179.0804	196.1957	223.3753	(45)
Energy content (annual)											Total = Sum(45)m =	2183.8576	
Distribution loss (46)m = 0.15 x (45)m	33.9795	29.8993	31.4140	26.8186	25.4453	22.3311	21.6199	22.8225	23.4508	26.8621	29.4294	33.5063	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	271.1703	239.6487	254.0664	221.9904	214.2752	192.0738	188.7727	196.7901	199.5386	223.7204	239.3957	268.0153	(62)
WWHRS	-32.0494	-28.3448	-29.6810	-24.5771	-22.9049	-19.5999	-18.3718	-19.5366	-20.2788	-23.9065	-27.0832	-31.4559	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	239.1209	211.3040	224.3853	197.4133	191.3702	172.4739	170.4010	177.2535	179.2598	199.8139	212.3125	236.5594	(64)
											Total per year (kWh/year) = Sum(64)m =	2411.6677	(64)
12Total per year (kWh/year)												2412	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	111.0333	98.5328	105.3463	94.0078	92.1157	84.0605	83.6361	86.3019	86.5426	95.2562	99.7951	109.9843	(65)

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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	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	136.8366	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	129.6372	143.5269	129.6372	133.9585	129.6372	133.9585	129.6372	129.6372	133.9585	129.6372	133.9585	129.6372	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.8419	258.4967	251.8066	237.5642	219.5856	202.6883	191.3999	188.7451	195.4352	209.6776	227.6562	244.5534	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	36.6837	(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)	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	-109.4693	(71)
Water heating gains (Table 5)	149.2383	146.6262	141.5944	130.5664	123.8114	116.7507	112.4142	115.9972	120.1980	128.0326	138.6043	147.8283	(72)
Total internal gains													

	598.7684	612.7008	587.0892	566.1400	537.0852	517.4485	497.5023	498.4305	513.6426	531.3984	564.2698	586.0700 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.3500	10.6334	0.6300	0.7000	0.7700	17.3859	(74)
East	15.1000	19.6403	0.6300	0.7000	0.7700	90.6350	(76)

Solar gains	108.0209	210.5267	348.4481	516.5362	644.0577	665.0312	630.7288	533.7755	407.4774	249.9334	134.4590	89.0276	(83)
Total gains	706.7893	823.2275	935.5373	1082.6761	1181.1429	1182.4797	1128.2310	1032.2059	921.1200	781.3318	698.7288	675.0976	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	129.6763	130.0617	130.4418	132.2568	132.6020	134.2330	134.2330	134.5395	133.6000	132.6020	131.9055	131.1851	
alpha	9.6451	9.6708	9.6961	9.8171	9.8401	9.9489	9.9489	9.9693	9.9067	9.8401	9.7937	9.7457	
util living area	0.9996	0.9981	0.9877	0.9002	0.6858	0.4695	0.3384	0.3858	0.6497	0.9619	0.9983	0.9998	(86)
MIT	20.4290	20.5536	20.7331	20.9344	20.9951	20.9999	21.0000	21.0000	20.9978	20.8832	20.6180	20.4115	(87)
Th 2	20.1668	20.1690	20.1713	20.1817	20.1837	20.1928	20.1928	20.1945	20.1893	20.1837	20.1797	20.1756	(88)
util rest of house	0.9994	0.9970	0.9812	0.8640	0.6284	0.4104	0.2763	0.3182	0.5753	0.9378	0.9971	0.9996	(89)
MIT 2	19.5030	19.6641	19.8915	20.1279	20.1809	20.1928	20.1928	20.1945	20.1884	20.0827	19.7558	19.4880	(90)
Living area fraction									fLA = Living area / (4) =			0.2152	(91)
MIT	19.7023	19.8556	20.0726	20.3015	20.3562	20.3665	20.3666	20.3679	20.3626	20.2550	19.9413	19.6868	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7023	19.8556	20.0726	20.3015	20.3562	20.3665	20.3666	20.3679	20.3626	20.2550	19.9413	19.6868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9992	0.9965	0.9802	0.8698	0.6407	0.4231	0.2897	0.3328	0.5914	0.9403	0.9966	0.9995	(94)
Useful gains	706.2573	820.3447	917.0310	941.6809	756.7385	500.2948	326.8173	343.4990	544.7177	734.7038	696.3765	674.7622	(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	1383.3936	1339.2865	1211.9024	1004.0709	760.3194	500.3503	326.8183	343.5029	545.9715	848.0521	1133.8825	1374.9854	(97)
Space heating kWh	503.7895	348.7289	219.3843	44.9208	2.6642	0.0000	0.0000	0.0000	0.0000	84.3311	315.0043	520.9661	(98a)
Space heating requirement - total per year (kWh/year)												2039.7892	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	503.7895	348.7289	219.3843	44.9208	2.6642	0.0000	0.0000	0.0000	0.0000	84.3311	315.0043	520.9661	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2039.7892	
Space heating per m2											(98c) / (4) =	20.4593	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:

Space heating requirement	503.7895	348.7289	219.3843	44.9208	2.6642	0.0000	0.0000	0.0000	0.0000	84.3311	315.0043	520.9661	(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25													
307a	351.3932	243.2384	153.0206	31.3322	1.8583	0.0000	0.0000	0.0000	0.0000	58.8210	219.7155	363.3739	
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25													
307b	278.3437	192.6727	121.2098	24.8187	1.4720	0.0000	0.0000	0.0000	0.0000	46.5930	174.0399	287.8338	
Space heating requirement	629.7368	435.9111	274.2304	56.1510	3.3302	0.0000	0.0000	0.0000	0.0000	105.4139	393.7554	651.2076	(307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

Annual water heating requirement	239.1209	211.3040	224.3853	197.4133	191.3702	172.4739	170.4010	177.2535	179.2598	199.8139	212.3125	236.5594	(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25													

310a	166.7868	147.3845	156.5088	137.6958	133.4807	120.3005	118.8547	123.6343	125.0337	139.3702	148.0880	165.0002	
Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25													
310b	132.1143	116.7454	123.9729	109.0709	105.7320	95.2918	94.1465	97.9326	99.0410	110.3972	117.3027	130.6991	
Water heating fuel	298.9011	264.1300	280.4817	246.7667	239.2128	215.5923	213.0012	221.5669	224.0747	249.7674	265.3906	295.6992	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	26.9361	21.6091	19.4566	14.2547	11.0108	8.9959	10.0444	13.0561	16.9586	22.2505	25.1319	27.6847	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-14.4370	-22.0056	-34.1563	-41.5519	-47.6106	-45.4456	-44.8621	-40.9265	-34.5465	-26.4648	-16.4377	-12.2948	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-3.8106	-8.2913	-17.0196	-26.3940	-35.7554	-36.2752	-35.8811	-30.0073	-21.4921	-12.1525	-5.1767	-2.9952	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												2549.7365	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3014.5846	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												25.4974	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(331)
Electricity for lighting (calculated in Appendix L)												217.3894	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-615.9903	(333)
Wind generation												0.0000	(334)
Hydro-electric generation (Appendix N)												0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(335)
Appendix Q - special features													
Energy saved or generated												-0.0000	(336)
Energy used												0.0000	(337)
Total delivered energy for all uses												5165.7202	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	2851.2084	0.2100	598.7538	(363)
less credit emissions for electricity	-912.3867	0.3480	-317.5106	(364)
Water heating from Combined Heat and Power	3371.0184	0.2100	707.9139	(365)
less credit emissions for electricity	-1078.7259	0.3480	-375.3966	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2619.2012	0.2100	252.0410	(368)
Electrical energy for heat distribution (space & water)	25.4974	0.0000	8.2743	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			1172.0670	(373)
Space and water heating			1172.0670	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	217.3894	0.1443	31.3760	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-380.7394	0.1330	-50.6435	
PV Unit electricity exported	-235.2509	0.1249	-29.3944	
Total			-80.0379	(380)
Total CO2, kg/year			1123.4051	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			11.2700	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	2851.2084	1.1300	3221.8654	(463)
less credit emissions for electricity	-912.3867	2.1490	-1960.7190	(464)
Water heating from Combined Heat and Power	3371.0184	1.1300	3809.2508	(465)
less credit emissions for electricity	-1078.7259	2.1490	-2318.1820	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2619.2012	1.1300	1356.2209	(468)
Electrical energy for heat distribution (space & water)	25.4974	0.0000	86.2550	(472)
Overall CO2 factor for heat network			1.0420	(486)
Total CO2 associated with community systems			5798.1677	(473)
Space and water heating			5798.1677	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	217.3894	1.5338	333.4391	(479)

Energy saving/generation technologies

PV Unit electricity used in dwelling	-380.7394	1.4915	-567.8750
PV Unit electricity exported	-235.2509	0.4586	-107.8861
Total			-675.7611 (480)
Total Primary energy kWh/year			5455.8456 (483)
Target Primary Energy Rate (TPER)			54.7200 (484)

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Property Reference	BH1+2 L03-6 03 x8_Copy	Issued on Date	12/09/2023
Assessment Reference	BH1+2 L03-6 03 x8_Copy	Prop Type Ref	
Property			

SAP Rating	89 B	DER	8.87	TER	10.63
Environmental	92 A	% DER < TER			16.56
CO_2 Emissions (t/year)	0.88	DFEE	26.92	TFEE	26.50
Compliance Check	See BREL	% DFEE < TFEE			-1.55
% DPER < TPER	12.32	DPER	45.26	TPER	51.62

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		115.1000 (1b)	x	2.7400 (2b)	=	315.3740 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.1000					(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	315.3740	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			3.0000 (17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.8000 (23c)

Effective ac	0.2986	0.2954	0.2922	0.2762	0.2731	0.2571	0.2571	0.2539	0.2635	0.2731	0.2794	0.2858	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.30)			17.7000	1.2357	21.8726			(27)
front door			2.3000	1.0000	2.3000			(26)
External Wall 1	66.4724	20.0000	46.4724	0.1400	6.5061	190.0000	8829.7560	(29a)

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Total net area of external elements Aum(A, m2)	66.4724					(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	30.6788				(33)
Party Wall 1	65.1000	0.0000	0.0000	180.0000	11718.0000	(32)
Party Floor 1	115.1000			40.0000	4604.0000	(32d)
Party Ceiling 1	115.1000			30.0000	3453.0000	(32b)
Internal Wall 1	194.0000			75.0000	14550.0000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	43154.7560 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		374.9327 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	11.0400	0.0300	0.3312	
E3 Sill	7.3400	0.0300	0.2202	
E4 Jamb	27.8800	0.0300	0.8364	
E7 Party floor between dwellings (in blocks of flats)	48.5200	0.0700	3.3964	
E8 Balcony within a dwelling, wall insulation continuous	3.4600	0.0000	0.0000	
E16 Corner (normal)	5.4800	0.0900	0.4932	
E18 Party wall between dwellings	10.9600	0.0600	0.6576	
E17 Corner (inverted - internal area greater than external area)	2.7400	0.0000	0.0000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		5.9350	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	36.6138	(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	31.0724	30.7407	30.4090	28.7503	28.4185	26.7599	26.7599	26.4281	27.4233	28.4185	29.0820	29.7455	(38)
Heat transfer coeff	67.6862	67.3544	67.0227	65.3640	65.0323	63.3736	63.3736	63.0419	64.0371	65.0323	65.6958	66.3592	(39)
Average = Sum(39)m / 12 =												65.2811	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.5881	0.5852	0.5823	0.5679	0.5650	0.5506	0.5506	0.5477	0.5564	0.5650	0.5708	0.5765	(40)
HLP (average)												0.5672	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8422	(42)
Hot water usage for mixer showers	98.8274	97.3422	95.1780	91.0372	87.9813	84.5735	82.6365	84.7843	87.1388	90.7977	95.0275	98.4487	(42a)
Hot water usage for baths	32.6648	32.1797	31.4966	30.2370	29.2938	28.2479	27.6830	28.3614	29.1000	30.2191	31.5047	32.5544	(42b)
Hot water usage for other uses	46.0391	44.3649	42.6908	41.0166	39.3425	37.6683	37.6683	39.3425	41.0166	42.6908	44.3649	46.0391	(42c)
Average daily hot water use (litres/day)												163.2547	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	177.5313	173.8868	169.3653	162.2908	156.6176	150.4898	147.9879	152.4883	157.2554	163.7076	170.8971	177.0422	(44)
Energy conte	281.1661	247.6125	260.3082	222.1679	210.8374	185.0448	178.9786	188.8123	193.9117	222.1497	243.4742	277.2053	(45)
Energy content (annual)										Total = Sum(45)m =		2711.6688	
Distribution loss (46)m = 0.15 x (45)m	42.1749	37.1419	39.0462	33.3252	31.6256	27.7567	26.8468	28.3218	29.0868	33.3225	36.5211	41.5808	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	336.4430	297.5400	315.5850	275.6616	266.1142	238.5385	234.2554	244.0891	247.4054	277.4265	296.9679	332.4821	(62)
WWHRS	-74.9664	-66.3009	-69.4264	-57.4878	-53.5766	-45.8459	-42.9732	-45.6977	-47.4339	-55.9193	-63.3498	-73.5781	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	261.4766	231.2391	246.1586	218.1738	212.5376	192.6926	191.2822	198.3914	199.9715	221.5072	233.6181	258.9040	(64)
										Total per year (kWh/year) = Sum(64)m =		2665.9526	(64)
12Total per year (kWh/year)												2666	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	137.7092	122.2731	130.7739	116.6658	114.3249	104.3223	103.7318	107.0015	107.2706	118.0862	123.7501	136.3922	(65)

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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	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	144.1344	159.5773	144.1344	148.9388	144.1344	148.9388	144.1344	144.1344	148.9388	144.1344	148.9388	144.1344 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	278.6893	281.5813	274.2937	258.7794	239.1953	220.7890	208.4925	205.6006	212.8882	228.4025	247.9866	266.3928 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111 (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)												
	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887 (71)
Water heating gains (Table 5)												
	185.0930	181.9540	175.7714	162.0358	153.6625	144.8921	139.4245	143.8193	148.9869	158.7180	171.8752	183.3229 (72)
Total internal gains												
	673.5499	688.7459	659.8327	635.3873	602.6254	580.2533	557.6846	559.1875	576.4472	596.8881	634.4338	659.4833 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	17.7000	19.6403	0.3300	0.8000	0.7700	63.6001	(76)
Solar gains	63.6001	124.4153	204.8942	298.8260	366.2225	374.8939	356.9143	306.5841	238.3005	147.6292	79.3018	52.3016	(83)
Total gains	737.1500	813.1611	864.7269	934.2133	968.8479	955.1472	914.5989	865.7716	814.7476	744.5173	713.7357	711.7849	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	177.1031	177.9754	178.8563	183.3949	184.3304	189.1549	189.1549	190.1502	187.1951	184.3304	182.4688	180.6445	
alpha	12.8069	12.8650	12.9238	13.2263	13.2887	13.6103	13.6103	13.6767	13.4797	13.2887	13.1646	13.0430	
util living area													
	0.9985	0.9937	0.9697	0.8308	0.6238	0.4246	0.3049	0.3350	0.5423	0.8773	0.9912	0.9990	(86)
MIT	20.7159	20.8008	20.9039	20.9893	20.9997	21.0000	21.0000	21.0000	21.0000	20.9833	20.8514	20.7086	(87)
Th 2	20.4408	20.4434	20.4460	20.4590	20.4616	20.4747	20.4747	20.4773	20.4694	20.4616	20.4564	20.4512	(88)
util rest of house													
	0.9979	0.9911	0.9586	0.7989	0.5879	0.3898	0.2685	0.2969	0.5006	0.8427	0.9870	0.9985	(89)
MIT 2	20.1836	20.2696	20.3697	20.4524	20.4614	20.4747	20.4747	20.4773	20.4694	20.4516	20.3314	20.1858	(90)
Living area fraction										fLA = Living area / (4) =		0.3090	(91)
MIT	20.3481	20.4338	20.5348	20.6183	20.6278	20.6370	20.6370	20.6388	20.6334	20.6159	20.4921	20.3474	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3481	20.4338	20.5348	20.6183	20.6278	20.6370	20.6370	20.6388	20.6334	20.6159	20.4921	20.3474	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9910	0.9606	0.8085	0.5990	0.4006	0.2797	0.3087	0.5135	0.8531	0.9873	0.9984	(94)
Useful gains	735.4891	805.8636	830.6459	755.3479	580.3362	382.5866	255.8402	267.2234	418.3530	635.1644	704.6892	710.6299	(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													
	1086.2358	1046.2705	940.6484	765.9553	580.5944	382.5875	255.8402	267.2234	418.3786	651.3554	879.8064	1071.5279	(97)
Space heating kWh													
	260.9555	161.5535	81.8418	7.6374	0.1921	0.0000	0.0000	0.0000	0.0000	12.0461	126.0844	268.5081	(98a)
Space heating requirement - total per year (kWh/year)												918.8189	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	260.9555	161.5535	81.8418	7.6374	0.1921	0.0000	0.0000	0.0000	0.0000	12.0461	126.0844	268.5081	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												918.8189	
Space heating per m2											(98c) / (4) =	7.9828	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0500	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
260.9555 161.5535 81.8418 7.6374 0.1921 0.0000 0.0000 0.0000 0.0000 12.0461 126.0844 268.5081		(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25		
307a 191.1173 118.3177 59.9389 5.5934 0.1407 0.0000 0.0000 0.0000 0.0000 8.8223 92.3411 196.6486		
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25		
307b 151.3868 93.7212 47.4785 4.4306 0.1114 0.0000 0.0000 0.0000 0.0000 6.9883 73.1447 155.7683		

Space heating requirement												
	342.5041	212.0389	107.4174	10.0240	0.2521	0.0000	0.0000	0.0000	0.0000	15.8106	165.4858	352.4169 (307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement												
	261.4766	231.2391	246.1586	218.1738	212.5376	192.6926	191.2822	198.3914	199.9715	221.5072	233.6181	258.9040 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25												
310a	191.4989	169.3537	180.2804	159.7850	155.6572	141.1232	140.0903	145.2969	146.4541	162.2263	171.0960	189.6148
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25												
310b	151.6891	134.1476	142.8027	126.5681	123.2984	111.7858	110.9676	115.0918	116.0084	128.5018	135.5277	150.1967
Water heating fuel												
	343.1880	303.5013	323.0831	286.3531	278.9556	252.9090	251.0578	260.3888	262.4625	290.7281	306.6237	339.8115 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	22.8746	20.6609	22.8746	22.1367	22.8746	22.1367	22.8746	22.8746	22.1367	22.8746	22.1367	22.8746 (331)
Lighting	26.4795	21.2429	19.1269	14.0132	10.8242	8.8434	9.8742	12.8348	16.6712	21.8735	24.7060	27.2155 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-10.0755	-15.7558	-25.1537	-31.5257	-36.9721	-35.6457	-35.1860	-31.6607	-26.0854	-19.2985	-11.6054	-8.5373 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												1205.9498 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												3499.0627 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												12.0595 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7000)												
mechanical ventilation fans (SFP = 0.7000)												269.3294 (330a)
Total electricity for the above, kWh/year												269.3294 (331)
Electricity for lighting (calculated in Appendix L)												213.7051 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-287.5017 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												4900.5453 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	1348.5370	0.2100	283.1928	(363)
less credit emissions for electricity	-431.5318	0.3480	-150.1731	(364)
Water heating from Combined Heat and Power	3912.7796	0.2100	821.6837	(365)
less credit emissions for electricity	-1252.0895	0.3480	-435.7271	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2214.7130	0.2100	119.2079	(368)
Electrical energy for heat distribution (space & water)	12.0595	0.0000	6.8457	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			990.9117	(373)
Space and water heating			990.9117	(376)
Pumps, fans and electric keep-hot	269.3294	0.1387	37.3593	(378)
Energy for lighting	213.7051	0.1443	30.8443	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-287.5017	0.1325	-38.0804	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-38.0804	(380)
Total CO2, kg/year			1021.0349	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			8.8700	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	1348.5370	1.1300	1523.8468	(463)
less credit emissions for electricity	-431.5318	2.1490	-927.3619	(464)

Water heating from Combined Heat and Power	3912.7796	1.1300	4421.4409 (465)
less credit emissions for electricity	-1252.0895	2.1490	-2690.7402 (466)
Efficiency of heat source Boilers			93.9000 (467b)
Space and Water heating from Boilers	2214.7130	1.1300	641.4523 (468)
Electrical energy for heat distribution (space & water)	12.0595	0.0000	72.3698 (472)
Overall CO2 factor for heat network			1.0419 (486)
Total CO2 associated with community systems			4902.1811 (473)
Space and water heating			4902.1811 (476)
Pumps, fans and electric keep-hot	269.3294	1.5128	407.4415 (478)
Energy for lighting	213.7051	1.5338	327.7881 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-287.5017	1.4894	-428.2046
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-428.2046 (480)
Total Primary energy kWh/year			5209.2060 (483)
Dwelling Primary energy Rate (DPER)			45.2600 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		115.1000 (1b)	x	2.7400 (2b)	=	315.3740 (1b) -	(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.1000						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	315.3740	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1268	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3768	(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) =	0.3203	(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													
	0.4084	0.4004	0.3924	0.3523	0.3443	0.3043	0.3043	0.2963	0.3203	0.3443	0.3603	0.3764	(22b)
Effective ac	0.5834	0.5802	0.5770	0.5621	0.5593	0.5463	0.5463	0.5439	0.5513	0.5593	0.5649	0.5708	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.20)			17.7000	1.1450	20.2672			(27)
External Wall 1	66.4724	20.0000	46.4724	0.1800	8.3650			(29a)
Total net area of external elements Aum(A, m2)			66.4724					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.9322			(33)
Party Wall 1			65.1000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	384.9327 (35)
List of Thermal Bridges	

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	11.0400	0.0500	0.5520	
E3 Sill	7.3400	0.0500	0.3670	
E4 Jamb	27.8800	0.0500	1.3940	
E7 Party floor between dwellings (in blocks of flats)	48.5200	0.0700	3.3964	
E8 Balcony within a dwelling, wall insulation continuous	3.4600	0.0000	0.0000	
E16 Corner (normal)	5.4800	0.0900	0.4932	
E18 Party wall between dwellings	10.9600	0.0600	0.6576	
E17 Corner (inverted – internal area greater than external area)	2.7400	-0.0900	-0.2466	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				6.6136 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	37.5458 (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	60.7157	60.3786	60.0483	58.4967	58.2064	56.8550	56.8550	56.6048	57.3755	58.2064	58.7937	59.4076	(38)
Heat transfer coeff													
	98.2615	97.9245	97.5941	96.0425	95.7522	94.4008	94.4008	94.1506	94.9214	95.7522	96.3395	96.9535	(39)
Average = Sum(39)m / 12 =												96.0411	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8537	0.8508	0.8479	0.8344	0.8319	0.8202	0.8202	0.8180	0.8247	0.8319	0.8370	0.8423	(40)
HLP (average)												0.8344	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8422 (42)
Hot water usage for mixer showers												
	71.8744	70.7943	69.2203	66.2088	63.9864	61.5080	60.0993	61.6613	63.3736	66.0347	69.1109	71.5991 (42a)
Hot water usage for baths												
	31.0316	30.5707	29.9217	28.7251	27.8291	26.8355	26.2989	26.9433	27.6450	28.7082	29.9294	30.9267 (42b)
Hot water usage for other uses												
	43.7371	42.1467	40.5563	38.9658	37.3754	35.7849	35.7849	37.3754	38.9658	40.5563	42.1467	43.7371 (42c)
Average daily hot water use (litres/day)												134.7980 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	146.6432	143.5117	139.6983	133.8998	129.1909	124.1285	122.1831	125.9801	129.9845	135.2991	141.1870	146.2629	(44)
Energy conte	232.2469	204.3588	214.7111	183.3021	173.9158	152.6305	147.7699	155.9896	160.2839	183.5996	201.1468	229.0123	(45)
Energy content (annual)											Total = Sum(45)m =	2238.9673	
Distribution loss (46)m = 0.15 x (45)m													
	34.8370	30.6538	32.2067	27.4953	26.0874	22.8946	22.1655	23.3984	24.0426	27.5399	30.1720	34.3518	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss													
	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage													
	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	276.8869	244.6788	259.3511	226.5021	218.5558	195.8305	192.4099	200.6296	203.4839	228.2396	244.3468	273.6523	(62)
WWHRS	-32.8580	-29.0599	-30.4298	-25.1971	-23.4828	-20.0944	-18.8353	-20.0294	-20.7904	-24.5096	-27.7664	-32.2495	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	244.0289	215.6189	228.9213	201.3050	195.0730	175.7361	173.5746	180.6002	182.6934	203.7300	216.5803	241.4028	(64)
											Total per year (kWh/year) = Sum(64)m =	2459.2646	(64)
12Total per year (kWh/year)												2459	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month													
	112.9341	100.2053	107.1035	95.5079	93.5390	85.3096	84.8455	87.5786	87.8544	96.7589	101.4413	111.8586	(65)

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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	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	142.1108	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	147.8272	163.6658	147.8272	152.7548	147.8272	152.7548	147.8272	147.8272	152.7548	147.8272	152.7548	147.8272	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	278.6893	281.5813	274.2937	258.7794	239.1953	220.7890	208.4925	205.6006	212.8882	228.4025	247.9866	266.3928	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	37.2111	(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)													
	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	-113.6887	(71)
Water heating gains (Table 5)													
	151.7932	149.1150	143.9563	132.6499	125.7245	118.4856	114.0396	117.7131	122.0200	130.0523	140.8907	150.3476	(72)

Total internal gains	643.9429	659.9953	631.7104	609.8173	578.3802	557.6627	535.9926	536.7741	553.2962	571.9152	607.2653	630.2008	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	17.7000	19.6403	0.6300	0.7000	0.7700	106.2411	(76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	106.2411	207.8301	342.2665	499.1753	611.7581	626.2432	596.2091	512.1348	398.0701	246.6079	132.4701	87.3675	(83)
Total gains	750.1840	867.8254	973.9769	1108.9926	1190.1382	1183.9059	1132.2017	1048.9089	951.3663	818.5231	739.7354	717.5683	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	125.2490	125.6801	126.1055	128.1428	128.5313	130.3713	130.3713	130.7178	129.6563	128.5313	127.7478	126.9388	
alpha	9.3499	9.3787	9.4070	9.5429	9.5688	9.6914	9.6914	9.7145	9.6438	9.5688	9.5165	9.4626	
util living area	0.9996	0.9983	0.9905	0.9249	0.7359	0.5099	0.3668	0.4129	0.6825	0.9688	0.9984	0.9998	(86)
MIT	20.3955	20.5180	20.6942	20.9072	20.9900	20.9997	21.0000	21.0000	20.9961	20.8620	20.5916	20.3807	(87)
Th 2	20.2070	20.2095	20.2120	20.2236	20.2258	20.2359	20.2359	20.2378	20.2320	20.2258	20.2214	20.2168	(88)
util rest of house	0.9995	0.9975	0.9858	0.8961	0.6800	0.4493	0.3032	0.3445	0.6097	0.9497	0.9975	0.9996	(89)
MIT 2	19.4990	19.6578	19.8826	20.1417	20.2196	20.2358	20.2359	20.2378	20.2303	20.0998	19.7622	19.4882	(90)
Living area fraction									fLA = Living area / (4) =			0.3090	(91)
MIT	19.7760	19.9236	20.1334	20.3783	20.4577	20.4719	20.4720	20.4733	20.4669	20.3353	20.0185	19.7640	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7760	19.9236	20.1334	20.3783	20.4577	20.4719	20.4720	20.4733	20.4669	20.3353	20.0185	19.7640	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9993	0.9971	0.9852	0.9024	0.6971	0.4680	0.3228	0.3656	0.6323	0.9530	0.9971	0.9995	(94)
Useful gains	749.6700	865.2946	959.5413	1000.7868	829.6584	554.1198	365.5179	383.4907	601.5628	780.0193	737.6030	717.2364	(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	1520.6976	1471.1783	1330.5401	1102.4025	838.5668	554.3085	365.5222	383.5046	604.3582	932.1773	1244.5645	1508.9874	(97)
Space heating kWh	573.6445	407.1538	276.0231	73.1633	6.6278	0.0000	0.0000	0.0000	0.0000	113.2055	365.0123	589.0628	(98a)
Space heating requirement - total per year (kWh/year)												2403.8932	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	573.6445	407.1538	276.0231	73.1633	6.6278	0.0000	0.0000	0.0000	0.0000	113.2055	365.0123	589.0628	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2403.8932	
Space heating per m2											(98c) / (4) =	20.8853	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:

Space heating requirement	573.6445	407.1538	276.0231	73.1633	6.6278	0.0000	0.0000	0.0000	0.0000	113.2055	365.0123	589.0628	(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25													
307a	400.1171	283.9898	192.5261	51.0314	4.6229	0.0000	0.0000	0.0000	0.0000	78.9608	254.5961	410.8713	
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25													
307b	316.9386	224.9525	152.5028	40.4227	3.6619	0.0000	0.0000	0.0000	0.0000	62.5460	201.6693	325.4572	
Space heating requirement	717.0557	508.9423	345.0289	91.4541	8.2848	0.0000	0.0000	0.0000	0.0000	141.5069	456.2654	736.3285	(307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

Annual water heating requirement	244.0289	215.6189	228.9213	201.3050	195.0730	175.7361	173.5746	180.6002	182.6934	203.7300	216.5803	241.4028	(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25													

310a	170.2102	150.3942	159.6726	140.4102	136.0634	122.5759	121.0683	125.9686	127.4287	142.1017	151.0648	168.3785	
Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25													
310b	134.8260	119.1294	126.4790	111.2210	107.7778	97.0942	95.9000	99.7816	100.9381	112.5608	119.6606	133.3751	
Water heating fuel	305.0362	269.5236	286.1516	251.6312	243.8412	219.6701	216.9682	225.7502	228.3668	254.6625	270.7254	301.7535	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	30.7156	24.6412	22.1866	16.2549	12.5557	10.2581	11.4538	14.8880	19.3381	25.3726	28.6583	31.5692	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-16.5497	-25.1592	-38.9454	-47.2409	-54.0009	-51.4934	-50.8305	-46.4351	-39.2880	-30.2018	-18.8204	-14.1011	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-4.5164	-9.8175	-20.1352	-31.2002	-42.2420	-42.8502	-42.3845	-35.4554	-25.4066	-14.3804	-6.1326	-3.5507	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												3004.8665	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												3074.0807	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												30.0487	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(331)
Electricity for lighting (calculated in Appendix L)												247.8922	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-711.1382	(333)
Wind generation												0.0000	(334)
Hydro-electric generation (Appendix N)												0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(335)
Appendix Q - special features													
Energy saved or generated												-0.0000	(336)
Energy used												0.0000	(337)
Total delivered energy for all uses												5615.7012	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	3360.1513	0.2100	705.6318	(363)
less credit emissions for electricity	-1075.2484	0.3480	-374.1864	(364)
Water heating from Combined Heat and Power	3437.5492	0.2100	721.8853	(365)
less credit emissions for electricity	-1100.0157	0.3480	-382.8055	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2861.4426	0.2100	297.0306	(368)
Electrical energy for heat distribution (space & water)	30.0487	0.0000	9.0652	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			1280.4933	(373)
Space and water heating			1280.4933	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	247.8922	0.1443	35.7785	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-433.0666	0.1331	-57.6284	
PV Unit electricity exported	-278.0717	0.1250	-34.7510	
Total			-92.3794	(380)
Total CO2, kg/year			1223.8924	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			10.6300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	3360.1513	1.1300	3796.9709	(463)
less credit emissions for electricity	-1075.2484	2.1490	-2310.7088	(464)
Water heating from Combined Heat and Power	3437.5492	1.1300	3884.4305	(465)
less credit emissions for electricity	-1100.0157	2.1490	-2363.9338	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2861.4426	1.1300	1598.3073	(468)
Electrical energy for heat distribution (space & water)	30.0487	0.0000	94.3294	(472)
Overall CO2 factor for heat network			1.0420	(486)
Total CO2 associated with community systems			6334.5185	(473)
Space and water heating			6334.5185	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	247.8922	1.5338	380.2254	(479)

Energy saving/generation technologies

PV Unit electricity used in dwelling	-433.0666	1.4917	-646.0137
PV Unit electricity exported	-278.0717	0.4587	-127.5469
Total			-773.5606 (480)
Total Primary energy kWh/year			5941.1833 (483)
Target Primary Energy Rate (TPER)			51.6200 (484)

Full SAP Calculation Printout

Property Reference	GREEN PLANNING			Issued on Date	12/09/2023
Assessment Reference	L01to5 - 09 x5_Copy_Copy		Prop Type Ref		
Property					

SAP Rating	87 B	DER	10.43	TER	11.66
Environmental	91 B	% DER < TER			10.55
CO_2 Emissions (t/year)	0.74	DFEE	22.43	TFEE	22.07
Compliance Check	See BREL	% DFEE < TFEE			-1.66
% DPER < TPER	5.87	DPER	54.14	TPER	57.52

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
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--------------------------------------------------------------------------------------------------
1. Overall dwelling characteristics
--------------------------------------------------------------------------------------------------
                                                                  Area          Storey height              Volume
                                                                  (m2)                (m)                  (m3)
Ground floor                                                  76.3000 (1b)    x      2.7400 (2b)    =     209.0620 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)            76.3000                                          (4)
Dwelling volume                                                                (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    209.0620 (5)


--------------------------------------------------------------------------------------------------
2. Ventilation rate
--------------------------------------------------------------------------------------------------
                                                                                                  m3 per hour

Number of open chimneys                                                                  0 * 80 =       0.0000 (6a)
Number of open flues                                                                     0 * 20 =       0.0000 (6b)
Number of chimneys / flues attached to closed fire                                       0 * 10 =       0.0000 (6c)
Number of flues attached to solid fuel boiler                                            0 * 20 =       0.0000 (6d)
Number of flues attached to other heater                                                 0 * 35 =       0.0000 (6e)
Number of blocked chimneys                                                               0 * 20 =       0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =      0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                      Yes
Pressure Test Method                                                                                        Blower Door
Measured/design AP50                                                                                         3.0000 (17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)            0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                      72.8000 (23c)

Effective ac   0.2986    0.2954    0.2922    0.2762    0.2731    0.2571    0.2571    0.2539    0.2635    0.2731    0.2794    0.2858 (25)


--------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
--------------------------------------------------------------------------------------------------
Element                                          Gross       Openings        NetArea        U-value          A x U        K-value          A x K
                                                  m2           m2              m2           W/m2K            W/K          kJ/m2K           kJ/K
glazing (Uw = 1.30)                                                          12.7700        1.2357         15.7804                            (27)
External Wall 1                                 47.8404       12.7700        35.0704        0.1400          4.9099       190.0000      6663.3760 (29a)
Total net area of external elements Aum(A, m2)                               47.8404                                                        (31)
```


Full SAP Calculation Printout

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Fabric heat loss, W/K = Sum (A x U)                                  (26)...(30) + (32) =     20.6903                          (33)
Party Wall 1                                                      17.4400        0.0000         0.0000       180.0000      3139.2000 (32)
Party Floor 1                                                     76.3000                                    40.0000      3052.0000 (32d)
Party Ceiling 1                                                   76.3000                                    30.0000      2289.0000 (32b)
Internal Wall 1                                                  155.5200                                     9.0000      1399.6800 (32c)

Heat capacity Cm = Sum(A x k)                                                (28)...(30) + (32) + (32a)...(32e) =  16543.2560 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                  216.8186 (35)
List of Thermal Bridges
        K1 Element                                                                    Length       Psi-value          Total
        E2 Other lintels (including other steel lintels)                              7.0000          0.0300         0.2100
        E3 Sill                                                                       4.7400          0.0300         0.1422
        E4 Jamb                                                                      13.9400          0.0300         0.4182
        E7 Party floor between dwellings (in blocks of flats)                        34.9200          0.0700         2.4444
        E8 Balcony within a dwelling, wall insulation continuous                      5.1400          0.0000         0.0000
        E16 Corner (normal)                                                           2.7400          0.0900         0.2466
        E18 Party wall between dwellings                                              5.4800          0.0600         0.3288
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                          3.7902 (36)
Point Thermal bridges                                                                                  (36a) =      0.0000
Total fabric heat loss                                                                  (33) + (36) + (36a) =     24.4805 (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           20.5980   20.3781   20.1582   19.0586   18.8387   17.7392   17.7392   17.5193   18.1790   18.8387   19.2785   19.7183 (38)
Heat transfer coeff
                45.0784   44.8585   44.6386   43.5391   43.3192   42.2196   42.2196   41.9997   42.6595   43.3192   43.7590   44.1988 (39)
Average = Sum(39)m / 12 =                                                                                           43.4841

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
HLP             0.5908    0.5879    0.5850    0.5706    0.5677    0.5533    0.5533    0.5505    0.5591    0.5677    0.5735    0.5793 (40)
HLP (average)                                                                                                       0.5699
Days in mont    31        28        31        30        31        30        31        31        30        31        30        31


--------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
--------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                   2.3889 (42)
Hot water usage for mixer showers
                88.3765   87.0484   85.1131   81.4101   78.6775   75.6300   73.8979   75.8186   77.9240   81.1960   84.9785   88.0379 (42a)
Hot water usage for baths
                27.7631   27.3508   26.7701   25.6995   24.8979   24.0090   23.5289   24.1054   24.7332   25.6844   26.7770   27.6692 (42b)
Hot water usage for other uses
                39.0948   37.6732   36.2516   34.8299   33.4083   31.9867   31.9867   33.4083   34.8299   36.2516   37.6732   39.0948 (42c)
Average daily hot water use (litres/day)                                                                          142.7617 (43)

                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Daily hot water use
                155.2345  152.0724  148.1348  141.9396  136.9837  131.6257  129.4134  133.3323  137.4872  143.1320  149.4287  154.8020 (44)
Energy conte    245.8534  216.5490  227.6776  194.3083  184.4064  161.8492  156.5143  165.0933  169.5354  194.2287  212.8886  242.3825 (45)
Energy content (annual)                                                                    Total = Sum(45)m =   2371.2867
Distribution loss  (46)m = 0.15 x (45)m
                36.8780   32.4824   34.1516   29.1462   27.6610   24.2774   23.4771   24.7640   25.4303   29.1343   31.9333   36.3574 (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)
Combi loss       0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (61)
Total heat required for water heating calculated for each month
                301.1302  266.4765  282.9544  247.8019  239.6832  215.3429  211.7911  220.3701  223.0291  249.5055  266.3823  297.6593 (62)
WWHRS           -67.0388  -59.2897  -62.0847  -51.4086  -47.9110  -40.9978  -38.4289  -40.8652  -42.4179  -50.0060  -56.6507  -65.7973 (63a)
PV diverter      -0.0000   -0.0000   -0.0000   -0.0000   -0.0000   -0.0000   -0.0000   -0.0000   -0.0000   -0.0000   -0.0000   -0.0000 (63b)
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 (63c)
FGHRS            0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63d)
Output from w/h
                234.0914  207.1868  220.8697  196.3933  191.7722  174.3451  173.3623  179.5048  180.6112  199.4996  209.7316  231.8620 (64)
                                                                                                 Total per year (kWh/year) = Sum(64)m =   2399.2300 (64)
12Total per year (kWh/year)                                                                                         2399 (64)
Electric shower(s)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (64a)
                                                                                  Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =     0.0000 (64a)
Heat gains from water heating, kWh/month
                125.9677  111.9445  119.9243  107.4024  105.5366   96.6098   96.2625   99.1149   99.1655  108.8025  113.5804  124.8136 (65)


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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           119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455  119.4455 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                108.0126  119.5854  108.0126  111.6131  108.0126  111.6131  108.0126  108.0126  111.6131  108.0126  111.6131  108.0126 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
```

	211.5344	213.7294	208.1979	196.4220	181.5571	167.5861	158.2527	156.0576	161.5891	173.3650	188.2299	202.2009 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445 (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)												
	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564 (71)
Water heating gains (Table 5)												
	169.3114	166.5841	161.1885	149.1701	141.8502	134.1803	129.3850	133.2190	137.7298	146.2399	157.7506	167.7603 (72)
Total internal gains												
	547.6921	558.7326	536.2327	516.0388	490.2536	472.2131	454.4840	456.1229	469.7656	486.4512	516.4272	536.8074 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	5.0000	46.7521	0.3300	0.8000	0.7700	42.7669	(78)
West	7.7700	19.6403	0.3300	0.8000	0.7700	27.9194	(80)

Solar gains	70.6863	124.6574	179.1652	232.0176	265.8449	265.6968	255.4843	230.5385	197.8107	140.3527	85.5055	59.9141 (83)
Total gains	618.3784	683.3900	715.3979	748.0564	756.0985	737.9099	709.9683	686.6615	667.5764	626.8039	601.9327	596.7215 (84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	101.9412	102.4409	102.9456	105.5454	106.0812	108.8439	108.8439	109.4137	107.7217	106.0812	105.0150	103.9700	
alpha	7.7961	7.8294	7.8630	8.0364	8.0721	8.2563	8.2563	8.2942	8.1814	8.0721	8.0010	7.9313	
util living area													
	0.9532	0.9097	0.8381	0.6913	0.5313	0.3661	0.2617	0.2814	0.4406	0.7040	0.8935	0.9596	(86)
MIT	20.7106	20.8218	20.9154	20.9827	20.9979	20.9999	21.0000	21.0000	20.9996	20.9835	20.8748	20.6982	(87)
Th 2	20.4383	20.4409	20.4435	20.4565	20.4591	20.4722	20.4722	20.4748	20.4669	20.4591	20.4539	20.4487	(88)
util rest of house													
	0.9444	0.8954	0.8167	0.6633	0.5009	0.3360	0.2303	0.2492	0.4067	0.6713	0.8753	0.9519	(89)
MIT 2	20.1842	20.2898	20.3758	20.4441	20.4578	20.4721	20.4722	20.4748	20.4668	20.4478	20.3517	20.1820	(90)
Living area fraction										fLA = Living area / (4) =		0.3662	(91)
MIT	20.3770	20.4846	20.5734	20.6413	20.6556	20.6654	20.6655	20.6671	20.6619	20.6440	20.5432	20.3711	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3770	20.4846	20.5734	20.6413	20.6556	20.6654	20.6655	20.6671	20.6619	20.6440	20.5432	20.3711	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9434	0.8966	0.8218	0.6729	0.5119	0.3470	0.2418	0.2610	0.4191	0.6826	0.8784	0.9507	(94)
Useful gains	583.3780	612.6974	587.9257	503.3611	387.0823	256.0526	171.6411	179.2157	279.7942	427.8451	528.7500	567.3049	(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													
	724.7238	699.1016	628.2154	511.2056	387.9491	256.0794	171.6421	179.2177	279.9269	435.0965	588.2614	714.7412	(97)
Space heating kWh													
	105.1613	58.0636	29.9755	5.6480	0.6449	0.0000	0.0000	0.0000	0.0000	5.3950	42.8482	109.6926	(98a)
Space heating requirement - total per year (kWh/year)												357.4292	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	105.1613	58.0636	29.9755	5.6480	0.6449	0.0000	0.0000	0.0000	0.0000	5.3950	42.8482	109.6926	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												357.4292	
Space heating per m2											(98c) / (4) =	4.6845	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0500	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
105.1613 58.0636 29.9755 5.6480 0.6449 0.0000 0.0000 0.0000 0.0000 5.3950 42.8482	109.6926	(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25		
307a 77.0175 42.5244 21.9533 4.1365 0.4723 0.0000 0.0000 0.0000 0.0000 3.9512 31.3810	80.3361	
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25		
307b 61.0067 33.6842 17.3895 3.2766 0.3741 0.0000 0.0000 0.0000 0.0000 3.1298 24.8573	63.6354	
Space heating requirement		

	138.0242	76.2085	39.3429	7.4131	0.8464	0.0000	0.0000	0.0000	0.0000	7.0810	56.2383	143.9715 (307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement												
	234.0914	207.1868	220.8697	196.3933	191.7722	174.3451	173.3623	179.5048	180.6112	199.4996	209.7316	231.8620 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25												
310a	171.4427	151.7384	161.7595	143.8336	140.4492	127.6860	126.9662	131.4648	132.2752	146.1085	153.6021	169.8099
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25												
310b	135.8023	120.1942	128.1320	113.9327	111.2519	101.1420	100.5718	104.1352	104.7771	115.7347	121.6705	134.5089
Water heating fuel												
	307.2450	271.9327	289.8915	257.7663	251.7010	228.8279	227.5380	235.6001	237.0523	261.8432	275.2727	304.3188 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	13.5389	12.2287	13.5389	13.1022	13.5389	13.1022	13.5389	13.5389	13.1022	13.5389	13.1022	13.5389 (331)
Lighting	19.8435	15.9192	14.3334	10.5013	8.1115	6.6272	7.3996	9.6183	12.4932	16.3917	18.5144	20.3950 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-2.7187	-4.3725	-7.1785	-9.2615	-11.1087	-10.8009	-10.6600	-9.4705	-7.6337	-5.4554	-3.1714	-2.2912 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												469.1258 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												3148.9894 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												4.6913 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)												
mechanical ventilation fans (SFP = 0.6250)												159.4098 (330a)
Total electricity for the above, kWh/year												159.4098 (331)
Electricity for lighting (calculated in Appendix L)												160.1482 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-84.1228 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												3853.5504 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	524.5936	0.2100	110.1647	(363)
less credit emissions for electricity	-167.8700	0.3480	-58.4187	(364)
Water heating from Combined Heat and Power	3521.3148	0.2100	739.4761	(365)
less credit emissions for electricity	-1126.8207	0.3480	-392.1336	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	1703.0958	0.2100	46.3730	(368)
Electrical energy for heat distribution (space & water)	4.6913	0.0000	5.1764	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			761.9149	(373)
Space and water heating			761.9149	(376)
Pumps, fans and electric keep-hot	159.4098	0.1387	22.1121	(378)
Energy for lighting	160.1482	0.1443	23.1143	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-84.1228	0.1319	-11.0974	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-11.0974	(380)
Total CO2, kg/year			796.0439	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.4300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	524.5936	1.1300	592.7908	(463)
less credit emissions for electricity	-167.8700	2.1490	-360.7525	(464)
Water heating from Combined Heat and Power	3521.3148	1.1300	3979.0857	(465)

less credit emissions for electricity	-1126.8207	2.1490	-2421.5377 (466)
Efficiency of heat source Boilers			93.9000 (467b)
Space and Water heating from Boilers	1703.0958	1.1300	249.5310 (468)
Electrical energy for heat distribution (space & water)	4.6913	0.0000	55.3239 (472)
Overall CO2 factor for heat network			1.0418 (486)
Total CO2 associated with community systems			3769.4083 (473)
Space and water heating			3769.4083 (476)
Pumps, fans and electric keep-hot	159.4098	1.5128	241.1551 (478)
Energy for lighting	160.1482	1.5338	245.6406 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-84.1228	1.4874	-125.1238
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-125.1238 (480)
Total Primary energy kWh/year			4131.0802 (483)
Dwelling Primary energy Rate (DPER)			54.1400 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		76.3000 (1b)	x	2.7400 (2b)	=	209.0620 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.3000					(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	209.0620	(5)

2. Ventilation rate

			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1435	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3935	(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) =	0.3345	(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	0.4265	0.4181	0.4097	0.3679	0.3596	0.3177	0.3177	0.3094	0.3345	0.3596	0.3763	0.3930	(22b)
Effective ac	0.5909	0.5874	0.5839	0.5677	0.5646	0.5505	0.5505	0.5479	0.5559	0.5646	0.5708	0.5772	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			12.7700	1.1450	14.6221			(27)
External Wall 1	47.8404	12.7700	35.0704	0.1800	6.3127			(29a)
Total net area of external elements Aum(A, m2)			47.8404					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		20.9348			(33)
Party Wall 1			17.4400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 226.8186 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	7.0000	0.0500	0.3500
E3 Sill	4.7400	0.0500	0.2370
E4 Jamb	13.9400	0.0500	0.6970
E7 Party floor between dwellings (in blocks of flats)	34.9200	0.0700	2.4444
E8 Balcony within a dwelling, wall insulation continuous	5.1400	0.0000	0.0000
E16 Corner (normal)	2.7400	0.0900	0.2466
E18 Party wall between dwellings	5.4800	0.0600	0.3288

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.3038 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 25.2386 (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	40.7686	40.5250	40.2862	39.1647	38.9549	37.9780	37.9780	37.7971	38.3543	38.9549	39.3794	39.8232	(38)
Heat transfer coeff	66.0072	65.7636	65.5248	64.4033	64.1935	63.2166	63.2166	63.0358	63.5929	64.1935	64.6180	65.0618	(39)
Average = Sum(39)m / 12 =												64.4023	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8651	0.8619	0.8588	0.8441	0.8413	0.8285	0.8285	0.8262	0.8335	0.8413	0.8469	0.8527	(40)
HLP (average)												0.8441	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.3889 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	64.2739	63.3079	61.9004	59.2074	57.2200	55.0037	53.7439	55.1408	56.6720	59.0517	61.8025	64.0276	(42a)
Hot water usage for baths	27.7631	27.3508	26.7701	25.6995	24.8979	24.0090	23.5289	24.1054	24.7332	25.6844	26.7770	27.6692	(42b)
Hot water usage for other uses	39.0948	37.6732	36.2516	34.8299	33.4083	31.9867	31.9867	33.4083	34.8299	36.2516	37.6732	39.0948	(42c)
Average daily hot water use (litres/day)												120.5398	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	131.1318	128.3319	124.9221	119.7369	115.5262	110.9993	109.2595	112.6545	116.2352	120.9876	126.2527	130.7916	(44)
Energy conte	207.6807	182.7429	192.0006	163.9138	155.5205	136.4866	132.1398	139.4898	143.3296	164.1790	179.8702	204.7881	(45)
Energy content (annual)										Total = Sum(45)m =		2002.1417	
Distribution loss (46)m = 0.15 x (45)m	31.1521	27.4114	28.8001	24.5871	23.3281	20.4730	19.8210	20.9235	21.4994	24.6269	26.9805	30.7182	(46)

Water storage loss:
Store volume 0.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 1.4400 (51)
Volume factor from Table 2a 0.0000 (52)
Temperature factor from Table 2b 1.0000 (53)
Enter (49) or (54) in (55) 1.4400 (55)

Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	252.3207	223.0629	236.6406	207.1138	200.1605	179.6866	176.7798	184.1298	186.5296	208.8190	223.0702	249.4281	(62)
WWHRS	-29.3833	-25.9869	-27.2119	-22.5326	-20.9995	-17.9694	-16.8435	-17.9114	-18.5919	-21.9178	-24.8302	-28.8392	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	222.9373	197.0761	209.4287	184.5812	179.1609	161.7172	159.9363	166.2185	167.9377	186.9013	198.2400	220.5889	(64)
										Total per year (kWh/year) = Sum(64)m =		2254.7241	(64)
12Total per year (kWh/year)												2255	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	104.7658	93.0180	99.5522	89.0613	87.4226	79.9418	79.6485	82.0924	82.2171	90.3015	94.3668	103.8040	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	119.4455	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	110.3566	122.1805	110.3566	114.0351	110.3566	114.0351	110.3566	110.3566	114.0351	110.3566	114.0351	110.3566	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	211.5344	213.7294	208.1979	196.4220	181.5571	167.5861	158.2527	156.0576	161.5891	173.3650	188.2299	202.2009	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	34.9445	(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)	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	-95.5564	(71)
Water heating gains (Table 5)	140.8143	138.4197	133.8067	123.6963	117.5034	111.0303	107.0544	110.3392	114.1904	121.3730	131.0650	139.5216	(72)
Total internal gains	521.5389	533.1632	511.1949	492.9871	468.2507	451.4852	434.4973	435.5870	448.6483	463.9282	492.1638	510.9127	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	5.0000	46.7521	0.6300	0.7000	0.7700	71.4402	(78)
West	7.7700	19.6403	0.6300	0.7000	0.7700	46.6380	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	118.0782	208.2345	299.2872	387.5748	444.0819	443.8344	426.7749	385.1042	330.4339	234.4528	142.8331	100.0837	(83)
Total gains	639.6171	741.3977	810.4821	880.5619	912.3326	895.3196	861.2722	820.6912	779.0821	698.3811	634.9969	610.9964	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.8298	73.0996	73.3660	74.6436	74.8876	76.0447	76.0447	76.2630	75.5948	74.8876	74.3956	73.8882	
alpha	5.8553	5.8733	5.8911	5.9762	5.9925	6.0696	6.0696	6.0842	6.0397	5.9925	5.9597	5.9259	
util living area	0.9822	0.9595	0.9134	0.7995	0.6356	0.4499	0.3227	0.3529	0.5554	0.8370	0.9593	0.9857	(86)
MIT	20.2387	20.4417	20.6626	20.8786	20.9723	20.9971	20.9997	20.9995	20.9902	20.8659	20.5340	20.2098	(87)
Th 2	20.1973	20.2000	20.2027	20.2153	20.2177	20.2287	20.2287	20.2307	20.2244	20.2177	20.2129	20.2079	(88)
util rest of house	0.9777	0.9501	0.8948	0.7648	0.5878	0.3965	0.2663	0.2941	0.4961	0.7992	0.9481	0.9820	(89)
MIT 2	19.3236	19.5777	19.8464	20.1008	20.1959	20.2270	20.2286	20.2305	20.2182	20.0950	19.7055	19.2957	(90)
Living area fraction									fLA = Living area / (4) =			0.3662	(91)
MIT	19.6587	19.8941	20.1453	20.3856	20.4803	20.5090	20.5109	20.5121	20.5009	20.3773	20.0089	19.6304	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6587	19.8941	20.1453	20.3856	20.4803	20.5090	20.5109	20.5121	20.5009	20.3773	20.0089	19.6304	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9740	0.9459	0.8933	0.7727	0.6041	0.4160	0.2870	0.3156	0.5175	0.8075	0.9447	0.9787	(94)
Useful gains	622.9942	701.2915	724.0330	680.3683	551.1850	372.4656	247.1458	259.0489	403.1586	563.9208	599.9110	597.9703	(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	1013.7829	986.0648	894.1078	739.7100	563.6348	373.5483	247.2362	259.2087	407.0525	627.6392	834.1455	1003.9306	(97)
Space heating kWh	290.7468	191.3677	126.5357	42.7260	9.2627	0.0000	0.0000	0.0000	0.0000	47.4065	168.6488	302.0344	(98a)
Space heating requirement - total per year (kWh/year)												1178.7286	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	290.7468	191.3677	126.5357	42.7260	9.2627	0.0000	0.0000	0.0000	0.0000	47.4065	168.6488	302.0344	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1178.7286	
Space heating per m2											(98c) / (4) =	15.4486	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	290.7468	191.3677	126.5357	42.7260	9.2627	0.0000	0.0000	0.0000	0.0000	47.4065	168.6488	302.0344	(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25													
307a	202.7959	133.4789	88.2586	29.8014	6.4607	0.0000	0.0000	0.0000	0.0000	33.0660	117.6326	210.6690	
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25													
307b	160.6376	105.7306	69.9109	23.6061	5.1176	0.0000	0.0000	0.0000	0.0000	26.1921	93.1785	166.8740	
Space heating requirement	363.4336	239.2096	158.1696	53.4075	11.5784	0.0000	0.0000	0.0000	0.0000	59.2581	210.8111	377.5430	(307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Annual water heating requirement	222.9373	197.0761	209.4287	184.5812	179.1609	161.7172	159.9363	166.2185	167.9377	186.9013	198.2400	220.5889	(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25													
310a	155.4988	137.4606	146.0765	128.7454	124.9647	112.7977	111.5556	115.9374	117.1365	130.3636	138.2724	153.8608	
Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25													

310b	123.1729	108.8845	115.7094	101.9811	98.9864	89.3488	88.3648	91.8357	92.7856	103.2629	109.5276	121.8754	
Water heating fuel	278.6717	246.3451	261.7859	230.7265	223.9512	202.1465	199.9204	207.7731	209.9221	233.6266	247.8000	275.7362	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	22.9299	18.3952	16.5629	12.1347	9.3732	7.6580	8.5505	11.1143	14.4364	18.9413	21.3941	23.5672	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-7.7606	-12.0565	-19.0696	-23.6564	-27.5257	-26.4350	-26.1049	-23.6166	-19.6412	-14.6930	-8.9155	-6.5855	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-1.5492	-3.4009	-7.0402	-11.0094	-15.0073	-15.2587	-15.0900	-12.5736	-8.9495	-5.0094	-2.1122	-1.2154	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												1473.4108	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												2818.4052	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												14.7341	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(331)
Electricity for lighting (calculated in Appendix L)												185.0576	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-314.2766	(333)
Wind generation												0.0000	(334)
Hydro-electric generation (Appendix N)												0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(335)
Appendix Q - special features													
Energy saved or generated												-0.0000	(336)
Energy used												0.0000	(337)
Total delivered energy for all uses												4162.5970	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	1647.6217	0.2100	346.0006	(363)
less credit emissions for electricity	-527.2389	0.3480	-183.4792	(364)
Water heating from Combined Heat and Power	3151.6435	0.2100	661.8451	(365)
less credit emissions for electricity	-1008.5259	0.3480	-350.9670	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	2020.2158	0.2100	145.6464	(368)
Electrical energy for heat distribution (space & water)	14.7341	0.0000	6.2922	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			903.9371	(373)
Space and water heating			903.9371	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	185.0576	0.1443	26.7095	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-216.0607	0.1326	-28.6570	
PV Unit electricity exported	-98.2158	0.1247	-12.2494	
Total			-40.9064	(380)
Total CO2, kg/year			889.7402	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			11.6600	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	1647.6217	1.1300	1861.8125	(463)
less credit emissions for electricity	-527.2389	2.1490	-1133.0365	(464)
Water heating from Combined Heat and Power	3151.6435	1.1300	3561.3571	(465)
less credit emissions for electricity	-1008.5259	2.1490	-2167.3222	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	2020.2158	1.1300	783.7165	(468)
Electrical energy for heat distribution (space & water)	14.7341	0.0000	66.1940	(472)
Overall CO2 factor for heat network			1.0419	(486)
Total CO2 associated with community systems			4471.8489	(473)
Space and water heating			4471.8489	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	185.0576	1.5338	283.8475	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-216.0607	1.4901	-321.9478	
PV Unit electricity exported	-98.2158	0.4577	-44.9579	

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Total	-366.9057 (480)
Total Primary energy kWh/year	4388.7907 (483)
Target Primary Energy Rate (TPER)	57.5200 (484)

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Property Reference	GREEN PLANNING			Issued on Date	12/09/2023
Assessment Reference	L011 - 01,2 x2_Copy			Prop Type Ref	
Property					
SAP Rating	87 B	DER	12.00	TER	13.34
Environmental	91 B	% DER < TER			10.04
CO_2 Emissions (t/year)	0.61	DFEE	16.92	TFEE	21.17
Compliance Check	See BREL	% DFEE < TFEE			20.07
% DPER < TPER	6.10	DPER	61.94	TPER	65.97
Assessor Details	Mr. Richard Denteh			Assessor ID	U148-0001
Client					

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		51.9000 (1b)	x	2.7400 (2b)	=	142.2060 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.9000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.2060	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			3.0000	(17)
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) =	0.1162	(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	0.1162	0.1250	0.1308	0.1366	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2842	0.2813	0.2784	0.2639	0.2610	0.2464	0.2464	0.2435	0.2522	0.2610	0.2668	0.2726	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
glazing (Uw = 1.30)			7.7700	1.2357	9.6017			(27)
External Wall 1	19.2348	7.7700	11.4648	0.1400	1.6051	190.0000	2178.3120	(29a)
External Roof 1	51.9000		51.9000	0.1000	5.1900	9.0000	467.1000	(30)

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Total net area of external elements Aum(A, m2)	71.1348				(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	16.3968			(33)
Party Wall 1	58.5300	0.0000	0.0000	180.0000	10535.4000 (32)
Party Floor 1	51.9000			40.0000	2076.0000 (32d)
Internal Wall 1	70.2000			75.0000	5265.0000 (32c)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =				20521.8120 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					395.4106 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	3.8400	0.0300	0.1152	
E3 Sill	1.5600	0.0300	0.0468	
E4 Jamb	7.7400	0.0300	0.2322	
E7 Party floor between dwellings (in blocks of flats)	7.0100	0.0700	0.4907	
E9 Balcony between dwellings, wall insulation continuous	7.0100	0.0200	0.1402	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	
E14 Flat roof	7.0100	0.0800	0.5608	
P4 Party wall - Roof (insulation at ceiling level)	21.3500	0.1200	2.5620	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.4767	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	20.8735	(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	13.3378	13.2014	13.0650	12.3831	12.2467	11.5648	11.5648	11.4284	11.8376	12.2467	12.5195	12.7923	(38)
Heat transfer coeff	34.2113	34.0749	33.9385	33.2566	33.1202	32.4383	32.4383	32.3019	32.7111	33.1202	33.3930	33.6658	(39)
Average = Sum(39)m / 12 =												33.2225	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6592	0.6565	0.6539	0.6408	0.6382	0.6250	0.6250	0.6224	0.6303	0.6382	0.6434	0.6487	(40)
HLP (average)												0.6401	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.7461 (42)
Hot water usage for mixer showers	73.5573	72.4519	70.8410	67.7590	65.4846	62.9481	61.5064	63.1051	64.8575	67.5808	70.7290	73.2755 (42a)
Hot water usage for baths	23.1283	22.7849	22.3012	21.4093	20.7415	20.0010	19.6010	20.0813	20.6043	21.3967	22.3069	23.0502 (42b)
Hot water usage for other uses	32.5120	31.3298	30.1475	28.9653	27.7830	26.6007	26.6007	27.7830	28.9653	30.1475	31.3298	32.5120 (42c)
Average daily hot water use (litres/day)												118.8174 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	129.1977	126.5665	123.2897	118.1336	114.0091	109.5499	107.7082	110.9694	114.4270	119.1250	124.3657	128.8376	(44)
Energy conte	204.6175	180.2290	189.4917	161.7190	153.4781	134.7043	130.2637	137.4033	141.0999	161.6515	177.1817	201.7286	(45)
Energy content (annual)										Total = Sum(45)m =		1973.5683	
Distribution loss (46)m = 0.15 x (45)m	30.6926	27.0343	28.4238	24.2578	23.0217	20.2057	19.5396	20.6105	21.1650	24.2477	26.5773	30.2593	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	259.8943	230.1564	244.7685	215.2126	208.7549	188.1980	185.5405	192.6801	194.5936	216.9283	230.6754	257.0054	(62)
WWHRS	-55.7975	-49.3478	-51.6742	-42.7882	-39.8771	-34.1231	-31.9850	-34.0128	-35.3051	-41.6208	-47.1513	-54.7642	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	204.0968	180.8086	193.0943	172.4244	168.8778	154.0749	153.5555	158.6672	159.2885	175.3075	183.5241	202.2412	(64)
									Total per year (kWh/year) = Sum(64)m =			2105.9609	(64)
12Total per year (kWh/year)												2106	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	112.2568	99.8681	107.2274	96.5665	95.2529	87.5841	87.5341	89.9080	89.7107	97.9706	101.7079	111.2962	(65)

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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	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.0664	87.5378	79.0664	81.7020	79.0664	81.7020	79.0664	79.0664	81.7020	79.0664	81.7020	79.0664	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	152.1665	153.7456	149.7665	141.2955	130.6025	120.5525	113.8385	112.2595	116.2386	124.7095	135.4026	145.4526 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306 (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)												
	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448 (71)
Water heating gains (Table 5)												
	150.8827	148.6132	144.1229	134.1201	128.0281	121.6446	117.6534	120.8441	124.5982	131.6809	141.2609	149.5917 (72)
Total internal gains												
	431.3075	439.0884	422.1476	406.3095	386.8888	373.0909	359.7502	361.3619	371.7305	384.6486	407.5573	423.3024 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	7.7700	46.7521	0.7600	0.8000	0.7700	153.0589	(78)
Solar gains	153.0589	250.6711	319.3105	360.8901	376.0699	361.9161	353.6140	343.4082	333.5575	270.3723	181.4270	132.2570 (83)
Total gains	584.3664	689.7595	741.4581	767.1996	762.9587	735.0070	713.3642	704.7701	705.2880	655.0209	588.9843	555.5594 (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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	166.6264	167.2933	167.9656	171.4097	172.1155	175.7337	175.7337	176.4757	174.2683	172.1155	170.7096	169.3265	
alpha	12.1084	12.1529	12.1977	12.4273	12.4744	12.7156	12.7156	12.7650	12.6179	12.4744	12.3806	12.2884	
util living area													
	0.9129	0.7848	0.6622	0.5244	0.4037	0.2825	0.2001	0.2108	0.3200	0.5258	0.7789	0.9327	(86)
MIT	20.9429	20.9890	20.9983	20.9999	21.0000	21.0000	21.0000	21.0000	21.0000	20.9999	20.9919	20.9285	(87)
Th 2	20.3770	20.3794	20.3817	20.3934	20.3958	20.4075	20.4075	20.4099	20.4028	20.3958	20.3911	20.3864	(88)
util rest of house													
	0.8927	0.7576	0.6345	0.4982	0.3775	0.2563	0.1731	0.1838	0.2923	0.4953	0.7478	0.9155	(89)
MIT 2	20.3343	20.3720	20.3807	20.3934	20.3958	20.4075	20.4075	20.4099	20.4028	20.3957	20.3860	20.3316	(90)
Living area fraction										fLA = Living area / (4) =		0.5451	(91)
MIT	20.6661	20.7083	20.7173	20.7240	20.7251	20.7305	20.7305	20.7316	20.7283	20.7251	20.7163	20.6569	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.6661	20.7083	20.7173	20.7240	20.7251	20.7305	20.7305	20.7316	20.7283	20.7251	20.7163	20.6569	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9024	0.7721	0.6496	0.5125	0.3918	0.2706	0.1878	0.1985	0.3074	0.5119	0.7646	0.9235	(94)
Useful gains	527.3587	532.5842	481.6196	393.1784	298.9128	198.8624	133.9858	139.9174	216.8200	335.3060	450.3420	513.0423	(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													
	559.9040	538.6663	482.5157	393.2258	298.9143	198.8624	133.9858	139.9174	216.8201	335.3446	454.6875	554.0353	(97)
Space heating kWh													
	24.2137	4.0872	0.6667	0.0341	0.0011	0.0000	0.0000	0.0000	0.0000	0.0287	3.1287	30.4987	(98a)
Space heating requirement - total per year (kWh/year)												62.6590	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	24.2137	4.0872	0.6667	0.0341	0.0011	0.0000	0.0000	0.0000	0.0000	0.0287	3.1287	30.4987	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												62.6590	
Space heating per m2											(98c) / (4) =	1.2073	(99)

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 Combined Heat and Power-Space and Water												0.5580	(303a)
Fraction of heat from community Boilers-Space and Water												0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating												1.0500	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0500	(305a)
Distribution loss factor (Table 12c) for community heating system												1.2500	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement													
	24.2137	4.0872	0.6667	0.0341	0.0011	0.0000	0.0000	0.0000	0.0000	0.0287	3.1287	30.4987	(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.05 x 1.25													
307a	17.7335	2.9934	0.4883	0.0250	0.0008	0.0000	0.0000	0.0000	0.0000	0.0210	2.2914	22.3365	
Space heat from Boilers = (98) x 0.44 x 1.05 x 1.25													
307b	14.0470	2.3711	0.3868	0.0198	0.0007	0.0000	0.0000	0.0000	0.0000	0.0167	1.8151	17.6931	
Space heating requirement													

	31.7805	5.3644	0.8750	0.0448	0.0015	0.0000	0.0000	0.0000	0.0000	0.0377	4.1065	40.0296 (307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (309)
Water heating												
Annual water heating requirement												
	204.0968	180.8086	193.0943	172.4244	168.8778	154.0749	153.5555	158.6672	159.2885	175.3075	183.5241	202.2412 (64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.05 x 1.25												
310a	149.4754	132.4197	141.4175	126.2793	123.6819	112.8406	112.4602	116.2039	116.6589	128.3908	134.4084	148.1164
Water heat from Boilers = (64) x 0.44 x 1.05 x 1.25												
310b	118.4016	104.8916	112.0189	100.0277	97.9702	89.3827	89.0814	92.0468	92.4073	101.7002	106.4669	117.3252
Water heating fuel												
	267.8770	237.3113	253.4363	226.3070	221.6521	202.2233	201.5416	208.2508	209.0662	230.0911	240.8753	265.4415 (310)
Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	8.6567	7.8190	8.6567	8.3775	8.6567	8.3775	8.6567	8.6567	8.3775	8.6567	8.3775	8.6567 (331)
Lighting	14.5256	11.6530	10.4922	7.6871	5.9377	4.8512	5.4166	7.0407	9.1451	11.9989	13.5527	14.9293 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-1.8205	-2.9326	-4.8225	-6.2327	-7.4863	-7.2833	-7.1888	-6.3820	-5.1372	-3.6635	-2.1253	-1.5338 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												82.2399 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2764.0736 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												0.8224 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.5875)												
mechanical ventilation fans (SFP = 0.5875)												101.9262 (330a)
Total electricity for the above, kWh/year												101.9262 (331)
Electricity for lighting (calculated in Appendix L)												117.2302 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-56.6085 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												3008.8614 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	91.9637	0.2100	19.3124	(363)
less credit emissions for electricity	-29.4284	0.3480	-10.2411	(364)
Water heating from Combined Heat and Power	3090.8879	0.2100	649.0865	(365)
less credit emissions for electricity	-989.0841	0.3480	-344.2013	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	1339.7983	0.2100	8.1294	(368)
Electrical energy for heat distribution (space & water)	0.8224	0.0000	4.0176	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			599.3317	(373)
Space and water heating			599.3317	(376)
Pumps, fans and electric keep-hot	101.9262	0.1387	14.1384	(378)
Energy for lighting	117.2302	0.1443	16.9199	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-56.6085	0.1319	-7.4659	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-7.4659	(380)
Total CO2, kg/year			622.9242	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.0000	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	91.9637	1.1300	103.9190	(463)
less credit emissions for electricity	-29.4284	2.1490	-63.2416	(464)
Water heating from Combined Heat and Power	3090.8879	1.1300	3492.7034	(465)

less credit emissions for electricity	-989.0841	2.1490	-2125.5418 (466)
Efficiency of heat source Boilers			93.9000 (467b)
Space and Water heating from Boilers	1339.7983	1.1300	43.7439 (468)
Electrical energy for heat distribution (space & water)	0.8224	0.0000	43.3185 (472)
Overall CO2 factor for heat network			1.0417 (486)
Total CO2 associated with community systems			2965.1296 (473)
Space and water heating			2965.1296 (476)
Pumps, fans and electric keep-hot	101.9262	1.5128	154.1939 (478)
Energy for lighting	117.2302	1.5338	179.8116 (479)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-56.6085	1.4873	-84.1922
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-84.1922 (480)
Total Primary energy kWh/year			3214.9428 (483)
Dwelling Primary energy Rate (DPER)			61.9400 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		51.9000 (1b)	x	2.7400 (2b)	=	142.2060 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	51.9000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		142.2060	(5)

2. Ventilation rate

			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		20.0000 / (5) =	0.1406	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3906	(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) =	0.3027	(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	0.3860	0.3784	0.3709	0.3330	0.3255	0.2876	0.2876	0.2800	0.3027	0.3255	0.3406	0.3557	(22b)
Effective ac	0.5745	0.5716	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5458	0.5530	0.5580	0.5633	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			7.7700	1.1450	8.8969			(27)
External Wall 1	19.2348	7.7700	11.4648	0.1800	2.0637			(29a)
External Roof 1	51.9000		51.9000	0.1100	5.7090			(30)
Total net area of external elements Aum(A, m2)			71.1348					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		16.6696			(33)
Party Wall 1			58.5300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 395.4106 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	3.8400	0.0500	0.1920	
E3 Sill	1.5600	0.0500	0.0780	
E4 Jamb	7.7400	0.0500	0.3870	
E7 Party floor between dwellings (in blocks of flats)	7.0100	0.0700	0.4907	
E9 Balcony between dwellings, wall insulation continuous	7.0100	0.0200	0.1402	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	
E14 Flat roof	7.0100	0.0800	0.5608	
P4 Party wall - Roof (insulation at ceiling level)	21.3500	0.1200	2.5620	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.7395 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 21.4091 (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	26.9601	26.8243	26.6912	26.0662	25.9493	25.4049	25.4049	25.3041	25.6146	25.9493	26.1859	26.4332	(38)
Heat transfer coeff	48.3692	48.2334	48.1004	47.4753	47.3584	46.8140	46.8140	46.7132	47.0237	47.3584	47.5950	47.8423	(39)
Average = Sum(39)m / 12 =												47.4748	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9320	0.9294	0.9268	0.9147	0.9125	0.9020	0.9020	0.9001	0.9060	0.9125	0.9171	0.9218	(40)
HLP (average)												0.9147	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7461 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
53.4962	52.6923	51.5208	49.2793	47.6252	45.7805	44.7320	45.8946	47.1691	49.1497	51.4393	53.2912	(42a)

Hot water usage for baths

23.1283	22.7849	22.3012	21.4093	20.7415	20.0010	19.6010	20.0813	20.6043	21.3967	22.3069	23.0502	(42b)

Hot water usage for other uses

32.5120	31.3298	30.1475	28.9653	27.7830	26.6007	26.6007	27.7830	28.9653	30.1475	31.3298	32.5120	(42c)

Average daily hot water use (litres/day) 100.3217 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.1366	106.8069	103.9694	99.6538	96.1496	92.3822	90.9337	93.7589	96.7386	100.6939	105.0759	108.8534	(44)
Energy conte	172.8457	152.0916	159.7971	136.4211	129.4359	113.5947	109.9764	116.0931	119.2884	136.6406	149.6999	170.4382	(45)
Energy content (annual)											Total = Sum(45)m =	1666.3227	
Distribution loss (46)m = 0.15 x (45)m	25.9268	22.8137	23.9696	20.4632	19.4154	17.0392	16.4965	17.4140	17.8933	20.4961	22.4550	25.5657	(46)
Water storage loss:													
Store volume												0.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												1.4400	(51)
Volume factor from Table 2a												0.0000	(52)
Temperature factor from Table 2b												1.0000	(53)
Enter (49) or (54) in (55)												1.4400	(55)
Total storage loss	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(56)
If cylinder contains dedicated solar storage	44.6400	40.3200	44.6400	43.2000	44.6400	43.2000	44.6400	44.6400	43.2000	44.6400	43.2000	44.6400	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	217.4857	192.4116	204.4371	179.6211	174.0759	156.7947	154.6164	160.7331	162.4884	181.2806	192.8999	215.0782	(62)
WWHRS	-24.4562	-21.6293	-22.6489	-18.7542	-17.4783	-14.9563	-14.0191	-14.9079	-15.4743	-18.2425	-20.6666	-24.0033	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	193.0294	170.7823	181.7882	160.8669	156.5976	141.8384	140.5973	145.8252	147.0140	163.0381	172.2334	191.0748	(64)
											Total per year (kWh/year) = Sum(64)m =	1964.6856	(64)
12Total per year (kWh/year)												1965	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	93.1832	82.8265	88.8445	79.9200	78.7494	72.3302	72.2792	74.3130	74.2234	81.1450	84.3352	92.3827	(65)

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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	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	87.3060	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	81.1655	89.8619	81.1655	83.8711	81.1655	83.8711	81.1655	81.1655	83.8711	81.1655	83.8711	81.1655	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	152.1665	153.7456	149.7665	141.2955	130.6025	120.5525	113.8385	112.2595	116.2386	124.7095	135.4026	145.4526	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	31.7306	(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)	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	-69.8448	(71)
Water heating gains (Table 5)	125.2462	123.2536	119.4147	111.0000	105.8460	100.4587	97.1494	99.8830	103.0880	109.0659	117.1323	124.1703	(72)
Total internal gains													

	407.7701	416.0529	399.5386	385.3585	366.8059	354.0741	341.3453	342.4999	352.3895	364.1328	385.5977	399.9802 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
South	7.7700	46.7521	0.6300	0.7000	0.7700	111.0181	(78)

Solar gains	111.0181	181.8190	231.6051	261.7641	272.7744	262.5082	256.4865	249.0839	241.9389	196.1088	131.5943	95.9298	(83)
Total gains	518.7882	597.8718	631.1437	647.1225	639.5802	616.5823	597.8318	591.5838	594.3284	560.2416	517.1920	495.9100	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	117.8540	118.1857	118.5127	120.0729	120.3694	121.7691	121.7691	122.0319	121.2262	120.3694	119.7711	119.1520	
alpha	8.8569	8.8790	8.9008	9.0049	9.0246	9.1179	9.1179	9.1355	9.0817	9.0246	8.9847	8.9435	
util living area	0.9928	0.9756	0.9378	0.8387	0.6810	0.4856	0.3445	0.3632	0.5449	0.8333	0.9739	0.9949	(86)
MIT	20.5743	20.7188	20.8463	20.9538	20.9929	20.9997	21.0000	21.0000	20.9991	20.9626	20.7699	20.5480	(87)
Th 2	20.1404	20.1426	20.1448	20.1550	20.1569	20.1658	20.1658	20.1674	20.1624	20.1569	20.1530	20.1490	(88)
util rest of house	0.9896	0.9658	0.9157	0.7956	0.6227	0.4225	0.2792	0.2975	0.4793	0.7822	0.9616	0.9925	(89)
MIT 2	19.6686	19.8480	19.9984	20.1186	20.1528	20.1657	20.1658	20.1674	20.1620	20.1300	19.9213	19.6428	(90)
Living area fraction									fLA = Living area / (4) =			0.5451	(91)
MIT	20.1623	20.3227	20.4606	20.5738	20.6107	20.6203	20.6205	20.6212	20.6183	20.5838	20.3839	20.1362	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1623	20.3227	20.4606	20.5738	20.6107	20.6203	20.6205	20.6212	20.6183	20.5838	20.3839	20.1362	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9681	0.9245	0.8178	0.6545	0.4569	0.3148	0.3333	0.5151	0.8091	0.9654	0.9924	(94)
Useful gains	513.4253	578.8096	583.5107	529.2043	418.5771	281.7124	188.2125	197.1823	306.1516	453.2953	499.2996	492.1567	(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	767.2448	743.8880	671.5091	554.2197	421.9977	281.8340	188.2159	197.1881	306.5150	472.8179	632.2448	762.4245	(97)
Space heating kWh	188.8417	110.9327	65.4708	18.0111	2.5449	0.0000	0.0000	0.0000	0.0000	14.5248	95.7206	201.0792	(98a)
Space heating requirement - total per year (kWh/year)												697.1258	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	188.8417	110.9327	65.4708	18.0111	2.5449	0.0000	0.0000	0.0000	0.0000	14.5248	95.7206	201.0792	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												697.1258	
Space heating per m2											(98c) / (4) =	13.4321	(99)

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 Combined Heat and Power-Space and Water	0.5580	(303a)
Fraction of heat from community Boilers-Space and Water	0.4420	(303b)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.2500	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
188.8417 110.9327 65.4708 18.0111 2.5449 0.0000 0.0000 0.0000 0.0000 14.5248 95.7206 201.0792		(98)
Space heat from Combined Heat and Power = (98) x 0.56 x 1.00 x 1.25		
307a 131.7171 77.3755 45.6659 12.5628 1.7751 0.0000 0.0000 0.0000 0.0000 10.1310 66.7651 140.2528		
Space heat from Boilers = (98) x 0.44 x 1.00 x 1.25		
307b 104.3351 61.2903 36.1726 9.9511 1.4061 0.0000 0.0000 0.0000 0.0000 8.0249 52.8856 111.0963		
Space heating requirement		
236.0522 138.6658 81.8385 22.5139 3.1811 0.0000 0.0000 0.0000 0.0000 18.1560 119.6507 251.3491		(307)
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 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(309)
Water heating		
Annual water heating requirement		
193.0294 170.7823 181.7882 160.8669 156.5976 141.8384 140.5973 145.8252 147.0140 163.0381 172.2334 191.0748		(64)
Water heat from Combined Heat and Power = (64) x 0.56 x 1.00 x 1.25		
310a 134.6380 119.1207 126.7973 112.2047 109.2268 98.9323 98.0666 101.7131 102.5423 113.7191 120.1328 133.2747		

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Water heat from Boilers = (64) x 0.44 x 1.00 x 1.25													
310b	106.6488	94.3572	100.4380	88.8790	86.5202	78.3657	77.6800	80.5684	81.2253	90.0785	95.1589	105.5688	
Water heating fuel	241.2868	213.4779	227.2352	201.0836	195.7470	177.2980	175.7466	182.2815	183.7675	203.7976	215.2917	238.8435	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	16.8646	13.5294	12.1817	8.9249	6.8938	5.6323	6.2888	8.1744	10.6177	13.9310	15.7350	17.3333	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-5.3149	-8.2773	-13.1250	-16.3263	-19.0405	-18.3068	-18.0832	-16.3413	-13.5608	-10.1095	-6.1140	-4.5083	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	-1.0177	-2.2370	-4.6351	-7.2537	-9.8909	-10.0537	-9.9380	-8.2757	-5.8869	-3.2923	-1.3871	-0.7980	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												871.4073	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												2455.8570	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												8.7141	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(331)
Electricity for lighting (calculated in Appendix L)												136.1070	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-213.7740	(333)
Wind generation												0.0000	(334)
Hydro-electric generation (Appendix N)												0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(335)
Appendix Q - special features													
Energy saved or generated												-0.0000	(336)
Energy used												0.0000	(337)
Total delivered energy for all uses												3249.5973	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Electrical efficiency of CHP unit			32.0000	(361)
Heat efficiency of CHP unit			49.9000	(362)
Space heating from Combined Heat and Power	974.4394	0.2100	204.6323	(363)
less credit emissions for electricity	-311.8206	0.3480	-108.5136	(364)
Water heating from Combined Heat and Power	2746.2289	0.2100	576.7081	(365)
less credit emissions for electricity	-878.7932	0.3480	-305.8200	(366)
Efficiency of heat source Boilers			93.9000	(367)
Space and Water heating from Boilers	1566.1883	0.2100	86.1385	(368)
Electrical energy for heat distribution (space & water)	8.7141	0.0000	4.8395	(372)
Overall CO2 factor for heat network			0.2106	(386)
Total CO2 associated with community systems			700.7458	(373)
Space and water heating			700.7458	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)
Energy for lighting	136.1070	0.1443	19.6444	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-149.1078	0.1326	-19.7685	
PV Unit electricity exported	-64.6661	0.1247	-8.0645	
Total			-27.8330	(380)
Total CO2, kg/year			692.5572	(383)
EPC Target Carbon Dioxide Emission Rate (TER)			13.3400	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Electrical efficiency of CHP unit			32.0000	(461)
Heat efficiency of CHP unit			49.9000	(462)
Space heating from Combined Heat and Power	974.4394	1.1300	1101.1166	(463)
less credit emissions for electricity	-311.8206	2.1490	-670.1025	(464)
Water heating from Combined Heat and Power	2746.2289	1.1300	3103.2386	(465)
less credit emissions for electricity	-878.7932	2.1490	-1888.5267	(466)
Efficiency of heat source Boilers			93.9000	(467b)
Space and Water heating from Boilers	1566.1883	1.1300	463.5070	(468)
Electrical energy for heat distribution (space & water)	8.7141	0.0000	51.1726	(472)
Overall CO2 factor for heat network			1.0419	(486)
Total CO2 associated with community systems			3466.6914	(473)
Space and water heating			3466.6914	(476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(478)
Energy for lighting	136.1070	1.5338	208.7654	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-149.1078	1.4899	-222.1514	

PV Unit electricity exported	-64.6661	0.4577	-29.5986
Total			-251.7500 (480)
Total Primary energy kWh/year			3423.7068 (483)
Target Primary Energy Rate (TPER)			65.9700 (484)

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Property Reference	L01-6.04 SO x6_Copy	Issued on Date	12/09/2023
Assessment Reference	L00.04 SO_Copy	Prop Type Ref	
Property			

SAP Rating	86 B	DER	2.45	TER	12.48
Environmental	98 A	% DER < TER			80.37
CO_2 Emissions (t/year)	0.16	DFEE	27.44	TFEE	27.80
Compliance Check	See BREL	% DFEE < TFEE			1.28
% DPER < TPER	61.58	DPER	26.06	TPER	67.82

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		72.0000 (1b)	x	2.7400 (2b)	=	197.2800 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.0000					(4)	
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.2800	(5)

2. Ventilation rate

			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		72.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2986	0.2954	0.2922	0.2762	0.2731	0.2571	0.2571	0.2539	0.2635	0.2731	0.2794	0.2858	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.30)			14.8000	1.2357	18.2890			(27)
External Wall 1	47.8404	14.8000	33.0404	0.1400	4.6257	190.0000	6277.6760	(29a)
Total net area of external elements Aum(A, m2)			47.8404					(31)

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Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	22.9146	(33)
Party Wall 1	58.2000	0.0000	0.0000	180.0000	10476.0000 (32)
Party Floor 1	72.0000			40.0000	2880.0000 (32d)
Party Ceiling 1	72.0000			30.0000	2160.0000 (32b)
Internal Wall 1	118.3600			75.0000	8877.0000 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =		30670.6760 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					425.9816 (35)

List of Thermal Bridges

	Length	Psi-value	Total	
K1 Element				
E2 Other lintels (including other steel lintels)	7.5700	0.0300	0.2271	
E3 Sill	5.9900	0.0300	0.1797	
E4 Jamb	17.1000	0.0300	0.5130	
E7 Party floor between dwellings (in blocks of flats)	34.9200	0.0700	2.4444	
E18 Party wall between dwellings	5.4800	0.0600	0.3288	
E16 Corner (normal)	2.7400	0.0900	0.2466	
E8 Balcony within a dwelling, wall insulation continuous	5.8000	0.0000	0.0000	
E17 Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)			3.6930 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	26.6076 (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	19.4371	19.2296	19.0221	17.9845	17.7770	16.7395	16.7395	16.5319	17.1545	17.7770	18.1921	18.6071	(38)
Heat transfer coeff	46.0448	45.8373	45.6297	44.5922	44.3847	43.3471	43.3471	43.1396	43.7621	44.3847	44.7997	45.2147	(39)
Average = Sum(39)m / 12 =												44.5403	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6395	0.6366	0.6337	0.6193	0.6165	0.6020	0.6020	0.5992	0.6078	0.6165	0.6222	0.6280	(40)
HLP (average)												0.6186	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2937	(42)
Hot water usage for mixer showers	86.1812	84.8860	82.9988	79.3878	76.7230	73.7513	72.0621	73.9351	75.9883	79.1790	82.8675	85.8510	(42a)
Hot water usage for baths	27.0765	26.6744	26.1081	25.0640	24.2822	23.4152	22.9470	23.5093	24.1216	25.0492	26.1148	26.9849	(42b)
Hot water usage for other uses	38.1196	36.7335	35.3473	33.9611	32.5749	31.1888	31.1888	32.5749	33.9611	35.3473	36.7335	38.1196	(42c)
Average daily hot water use (litres/day)												139.2145	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.3773	148.2938	144.4541	138.4129	133.5801	128.3553	126.1979	130.0194	134.0709	139.5755	145.7158	150.9555	(44)
Energy conte	239.7446	211.1684	222.0206	189.4803	179.8245	157.8278	152.6254	160.9911	165.3229	189.4026	207.5988	236.3599	(45)
Energy content (annual)										Total = Sum(45)m =		2312.3670	
Distribution loss (46)m = 0.15 x (45)m	35.9617	31.6753	33.3031	28.4221	26.9737	23.6742	22.8938	24.1487	24.7984	28.4104	31.1398	35.4540	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5200	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.9120	(55)
Total storage loss	28.2720	25.5360	28.2720	27.3600	28.2720	27.3600	28.2720	28.2720	27.3600	28.2720	27.3600	28.2720	(56)
If cylinder contains dedicated solar storage	28.2720	25.5360	28.2720	27.3600	28.2720	27.3600	28.2720	28.2720	27.3600	28.2720	27.3600	28.2720	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	291.2790	257.7156	273.5550	239.3523	231.3589	207.6998	204.1598	212.5255	215.1949	240.9370	257.4708	287.8943	(62)
WWHRS	-65.3735	-57.8168	-60.5425	-50.1315	-46.7208	-39.9793	-37.4742	-39.8501	-41.3641	-48.7638	-55.2434	-64.1628	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	225.9055	199.8988	213.0125	189.2208	184.6381	167.7205	166.6856	172.6754	173.8307	192.1732	202.2274	223.7314	(64)
									Total per year (kWh/year) = Sum(64)m =			2311.7201	(64)
12Total per year (kWh/year)												2312	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	120.9426	107.4513	115.0494	102.8998	101.0192	92.3754	91.9755	94.7571	94.8675	104.2039	108.9242	119.8172	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	(66)m
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	101.8450	112.7570	101.8450	105.2399	101.8450	105.2399	101.8450	101.8450	105.2399	101.8450	105.2399	101.8450	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	201.9192	204.0145	198.7344	187.4938	173.3045	159.9686	151.0594	148.9641	154.2442	165.4848	179.6741	193.0100	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	(71)
Water heating gains (Table 5)												
	162.5572	159.8977	154.6362	142.9164	135.7785	128.2991	123.6230	127.3617	131.7604	140.0590	151.2836	161.0446 (72)
Total internal gains												
	523.7267	534.0745	512.6210	493.0553	468.3333	450.9128	433.9326	435.5761	448.6497	464.7941	493.6028	513.3049 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.6500	10.6334	0.3300	0.8000	0.7700	22.6639	(74)
West	3.1500	19.6403	0.3300	0.8000	0.7700	11.3187	(80)

Solar gains	33.9826	65.4536	110.0617	171.3974	224.4236	237.1985	222.6836	180.8387	130.8975	77.8302	42.0719	28.2017	(83)
Total gains	557.7093	599.5281	622.6827	664.4527	692.7569	688.1114	656.6163	616.4147	579.5471	542.6242	535.6747	541.5065	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	185.0293	185.8670	186.7123	191.0567	191.9500	196.5445	196.5445	197.4900	194.6806	191.9500	190.1717	188.4261	
alpha	13.3353	13.3911	13.4475	13.7371	13.7967	14.1030	14.1030	14.1660	13.9787	13.7967	13.6781	13.5617	
util living area													
	0.9962	0.9878	0.9554	0.8029	0.5957	0.4032	0.2905	0.3219	0.5210	0.8357	0.9800	0.9971	(86)
MIT	20.7829	20.8516	20.9321	20.9938	20.9999	21.0000	21.0000	21.0000	21.0000	20.9917	20.9003	20.7762	(87)
Th 2	20.3946	20.3971	20.3997	20.4126	20.4152	20.4282	20.4282	20.4308	20.4230	20.4152	20.4100	20.4049	(88)
util rest of house													
	0.9943	0.9824	0.9390	0.7674	0.5583	0.3671	0.2527	0.2821	0.4774	0.7949	0.9704	0.9956	(89)
MIT 2	20.1511	20.2386	20.3350	20.4081	20.4151	20.4282	20.4282	20.4308	20.4230	20.4096	20.3100	20.1518	(90)
Living area fraction										fLA = Living area / (4) =		0.3778	(91)
MIT	20.3898	20.4702	20.5606	20.6294	20.6360	20.6442	20.6442	20.6458	20.6410	20.6295	20.5330	20.3877	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3898	20.4702	20.5606	20.6294	20.6360	20.6442	20.6442	20.6458	20.6410	20.6295	20.5330	20.3877	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9831	0.9438	0.7807	0.5724	0.3807	0.2670	0.2971	0.4939	0.8102	0.9727	0.9956	(94)
Useful gains	554.5295	589.4134	587.7029	518.7543	396.5457	261.9978	175.3038	183.1621	286.2384	439.6547	521.0464	539.1101	(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													
	740.8498	713.6956	641.5802	523.0379	396.6229	261.9980	175.3038	183.1621	286.2460	445.1548	601.7950	731.9223	(97)
Space heating kWh													
	138.6223	83.5176	40.0848	3.0842	0.0575	0.0000	0.0000	0.0000	0.0000	4.0921	58.1390	143.4523	(98a)
Space heating requirement - total per year (kWh/year)												471.0497	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	138.6223	83.5176	40.0848	3.0842	0.0575	0.0000	0.0000	0.0000	0.0000	4.0921	58.1390	143.4523	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												471.0497	
Space heating per m2											(98c) / (4) =	6.5424	(99)

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 Heat pump-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.1000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
138.6223 83.5176 40.0848 3.0842 0.0575 0.0000 0.0000 0.0000 0.0000 4.0921 58.1390 143.4523		(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10		
307a 152.4846 91.8694 44.0932 3.3926 0.0632 0.0000 0.0000 0.0000 0.0000 4.5013 63.9529 157.7975		
Space heating requirement		
152.4846 91.8694 44.0932 3.3926 0.0632 0.0000 0.0000 0.0000 0.0000 4.5013 63.9529 157.7975		(307)
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 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(309)

Full SAP Calculation Printout

Water heating

Annual water heating requirement

225.9055 199.8988 213.0125 189.2208 184.6381 167.7205 166.6856 172.6754 173.8307 192.1732 202.2274 223.7314 (64)

Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10

310a 248.4960 219.8887 234.3138 208.1429 203.1019 184.4926 183.3542 189.9430 191.2138 211.3906 222.4501 246.1046

Water heating fuel

248.4960 219.8887 234.3138 208.1429 203.1019 184.4926 183.3542 189.9430 191.2138 211.3906 222.4501 246.1046 (310)

Cooling System Energy Efficiency Ratio												0.0000 (314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (315)
Pumps and Fa	12.7759	11.5395	12.7759	12.3638	12.7759	12.3638	12.7759	12.7759	12.3638	12.7759	12.3638	12.7759 (331)
Lighting	18.7104	15.0102	13.5150	9.9017	7.6483	6.2488	6.9771	9.0691	11.7798	15.4557	17.4572	19.2304 (332)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333a)m	-3.1377	-5.0265	-8.2200	-10.5622	-12.6292	-12.2650	-12.1052	-10.7735	-8.7105	-6.2552	-3.6537	-2.6464 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)												
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (335b)
Annual totals kWh/year												
Space heating fuel - community heating												518.1547 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2542.8921 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												5.1815 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)												
mechanical ventilation fans (SFP = 0.6250)												150.4260 (330a)
Total electricity for the above, kWh/year												150.4260 (331)
Electricity for lighting (calculated in Appendix L)												151.0036 (332)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-95.9852 (333)
Wind generation												0.0000 (334)
Hydro-electric generation (Appendix N)												0.0000 (335a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (335)
Appendix Q - special features												
Energy saved or generated												-0.0000 (336)
Energy used												0.0000 (337)
Total delivered energy for all uses												3266.4912 (338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			310.0000	(367)
Space and Water heating from Heat pump	987.4344	0.1598	26.7045	(367)
Electrical energy for heat distribution (space & water)	5.1815	0.0000	4.4044	(372)
Overall CO2 factor for heat network			0.0479	(386)
Total CO2 associated with community systems			146.4825	(373)
Space and water heating			146.4825	(376)
Pumps, fans and electric keep-hot	150.4260	0.1387	20.8659	(378)
Energy for lighting	151.0036	0.1443	21.7945	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-95.9852	0.1320	-12.6694	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-12.6694	(380)
Total CO2, kg/year			176.4736	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.4500	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			310.0000	(467a)
Space and Water heating from Heat pump	987.4344	1.5914	265.9893	(467)
Electrical energy for heat distribution (space & water)	5.1815	0.0000	46.8992	(472)
Overall CO2 factor for heat network			0.5096	(486)
Total CO2 associated with community systems			1559.7757	(473)
Space and water heating			1559.7757	(476)
Pumps, fans and electric keep-hot	150.4260	1.5128	227.5645	(478)
Energy for lighting	151.0036	1.5338	231.6144	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-95.9852	1.4877	-142.7945	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-142.7945	(480)
Total Primary energy kWh/year			1876.1600	(483)
Dwelling Primary energy Rate (DPER)			26.0600	(484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.0000 (1b)	x	2.7400 (2b)	=	197.2800 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.2800 (5)	

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1521	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4021	(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) =	0.3418	(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	0.4357	0.4272	0.4187	0.3759	0.3674	0.3247	0.3247	0.3161	0.3418	0.3674	0.3845	0.4016	(22b)
Effective ac	0.5949	0.5912	0.5876	0.5707	0.5675	0.5527	0.5527	0.5500	0.5584	0.5675	0.5739	0.5806	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			14.8000	1.1450	16.9466			(27)
External Wall 1	47.8404	14.8000	33.0404	0.1800	5.9473			(29a)
Total net area of external elements Aum(A, m2)			47.8404					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		22.8938			(33)
Party Wall 1			58.2000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	435.9816	(35)

List of Thermal Bridges

		Length	Psi-value	Total	
K1	Element				
E2	Other lintels (including other steel lintels)	7.5700	0.0500	0.3785	
E3	Sill	5.9900	0.0500	0.2995	
E4	Jamb	17.1000	0.0500	0.8550	
E7	Party floor between dwellings (in blocks of flats)	34.9200	0.0700	2.4444	
E18	Party wall between dwellings	5.4800	0.0600	0.3288	
E16	Corner (normal)	2.7400	0.0900	0.2466	
E8	Balcony within a dwelling, wall insulation continuous	5.8000	0.0000	0.0000	
E17	Corner (inverted – internal area greater than external area)	2.7400	-0.0900	-0.2466	

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.3062	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	27.2000	(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	38.7317	38.4917	38.2565	37.1515	36.9448	35.9824	35.9824	35.8042	36.3531	36.9448	37.3630	37.8002	(38)
Heat transfer coeff	65.9317	65.6918	65.4565	64.3516	64.1448	63.1825	63.1825	63.0043	63.5532	64.1448	64.5631	65.0003	(39)
Average = Sum(39)m / 12 =												64.3506	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9157	0.9124	0.9091	0.8938	0.8909	0.8775	0.8775	0.8751	0.8827	0.8909	0.8967	0.9028	(40)
HLP (average)												0.8938	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2937 (42)
Hot water usage for mixer showers	62.6772	61.7353	60.3627	57.7366	55.7986	53.6373	52.4088	53.7710	55.2642	57.5847	60.2673	62.4371 (42a)
Hot water usage for baths	27.0765	26.6744	26.1081	25.0640	24.2822	23.4152	22.9470	23.5093	24.1216	25.0492	26.1148	26.9849 (42b)
Hot water usage for other uses	38.1196	36.7335	35.3473	33.9611	32.5749	31.1888	31.1888	32.5749	33.9611	35.3473	36.7335	38.1196 (42c)
Average daily hot water use (litres/day)												117.5446 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	127.8733	125.1431	121.8181	116.7617	112.6557	108.2413	106.5446	109.8552	113.3469	117.9812	123.1155	127.5416	(44)
Energy conte	202.5201	178.2021	187.2299	159.8409	151.6562	133.0953	128.8565	136.0237	139.7680	160.0994	175.4006	199.6994	(45)
Energy content (annual)											Total = Sum(45)m =	1952.3920	
Distribution loss (46)m = 0.15 x (45)m	30.3780	26.7303	28.0845	23.9761	22.7484	19.9643	19.3285	20.4036	20.9652	24.0149	26.3101	29.9549	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	251.7627	222.6793	236.4725	207.4951	200.8989	180.7495	178.0991	185.2664	187.4222	209.3420	223.0548	248.9420	(62)
WWHRS	-28.6534	-25.3413	-26.5360	-21.9728	-20.4779	-17.5231	-16.4251	-17.4664	-18.1300	-21.3733	-24.2134	-28.1228	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	223.1093	197.3380	209.9366	185.5223	180.4210	163.2265	161.6740	167.8000	169.2922	187.9687	198.8415	220.8192	(64)
									Total per year (kWh/year) = Sum(64)m =			2265.9493	(64)
12Total per year (kWh/year)												2266	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	106.7321	94.8340	101.6481	91.2705	89.8198	82.3776	82.2389	84.6220	84.5962	92.6272	96.4441	105.7942	(65)

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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	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	114.6842	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	102.2951	113.2553	102.2951	105.7050	102.2951	105.7050	102.2951	102.2951	105.7050	102.2951	105.7050	102.2951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	201.9192	204.0145	198.7344	187.4938	173.3045	159.9686	151.0594	148.9641	154.2442	165.4848	179.6741	193.0100	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	34.4684	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	-91.7474	(71)
Water heating gains (Table 5)	143.4571	141.1220	136.6237	126.7645	120.7256	114.4133	110.5362	113.7393	117.4948	124.4989	133.9501	142.1965	(72)
Total internal gains	508.0767	518.7971	498.0586	480.3686	456.7305	437.4921	421.2960	422.4038	434.8492	452.6841	479.7344	497.9068	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.6500	10.6334	0.6300	0.7000	0.7700	37.8590	(74)
West	3.1500	19.6403	0.6300	0.7000	0.7700	18.9073	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	56.7663	109.3373	183.8531	286.3115	374.8894	396.2294	371.9829	302.0828	218.6582	130.0117	70.2792	47.1096	(83)
Total gains	564.8430	628.1344	681.9117	766.6801	831.6199	833.7215	793.2788	724.4866	653.5074	582.6958	550.0136	545.0165	(84)

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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, ni1,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	132.2524	132.7356	133.2126	135.4999	135.9366	138.0071	138.0071	138.3975	137.2022	135.9366	135.0561	134.1476	
alpha	9.8168	9.8490	9.8808	10.0333	10.0624	10.2005	10.2005	10.2265	10.1468	10.0624	10.0037	9.9432	
util living area													
	0.9993	0.9976	0.9890	0.9162	0.7100	0.4849	0.3504	0.4000	0.6671	0.9582	0.9971	0.9995	(86)
MIT	20.4830	20.5846	20.7351	20.9264	20.9941	20.9999	21.0000	21.0000	20.9975	20.8949	20.6630	20.4720	(87)
Th 2	20.1542	20.1570	20.1598	20.1728	20.1752	20.1866	20.1866	20.1888	20.1822	20.1752	20.1703	20.1651	(88)
util rest of house													
	0.9989	0.9962	0.9828	0.8822	0.6505	0.4233	0.2857	0.3295	0.5903	0.9316	0.9951	0.9992	(89)
MIT 2	19.5595	19.6914	19.8827	20.1120	20.1720	20.1866	20.1866	20.1887	20.1813	20.0868	19.8029	19.5546	(90)
Living area fraction									fLA = Living area / (4) =			0.3778	(91)
MIT	19.9084	20.0288	20.2047	20.4197	20.4826	20.4938	20.4939	20.4952	20.4896	20.3921	20.1278	19.9011	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9084	20.0288	20.2047	20.4197	20.4826	20.4938	20.4939	20.4952	20.4896	20.3921	20.1278	19.9011	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9987	0.9960	0.9832	0.8933	0.6730	0.4466	0.3101	0.3561	0.6195	0.9398	0.9950	0.9991	(94)
Useful gains	564.1361	625.5974	670.4449	684.8796	559.6967	372.3318	246.0255	258.0118	404.8458	547.5963	547.2713	544.5195	(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													
	1029.0870	993.8388	897.0630	741.3085	563.3554	372.3872	246.0266	258.0161	406.0825	628.1106	841.1175	1020.5787	(97)
Space heating kWh													
	345.9235	247.4582	168.6039	40.6288	2.7220	0.0000	0.0000	0.0000	0.0000	59.9027	211.5693	354.1880	(98a)
Space heating requirement - total per year (kWh/year)												1430.9965	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	345.9235	247.4582	168.6039	40.6288	2.7220	0.0000	0.0000	0.0000	0.0000	59.9027	211.5693	354.1880	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1430.9965	
Space heating per m2											(98c) / (4) =	19.8750	(99)

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 %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	345.9235	247.4582	168.6039	40.6288	2.7220	0.0000	0.0000	0.0000	0.0000	59.9027	211.5693	354.1880	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	374.7817	268.1021	182.6695	44.0182	2.9491	0.0000	0.0000	0.0000	0.0000	64.9000	229.2192	383.7357	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	223.1093	197.3380	209.9366	185.5223	180.4210	163.2265	161.6740	167.8000	169.2922	187.9687	198.8415	220.8192	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.0395	84.5685	83.5727	81.2800	79.9204	79.8000	79.8000	79.8000	79.8000	81.8037	84.1992	85.1136	(217)
Fuel for water heating, kWh/month													
	262.3595	233.3471	251.2024	228.2510	225.7509	204.5444	202.5991	210.2757	212.1456	229.7804	236.1561	259.4406	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	21.2549	17.0515	15.3530	11.2482	8.6885	7.0986	7.9259	10.3024	13.3818	17.5576	19.8313	21.8456	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-7.9527	-12.3348	-19.4826	-24.1407	-28.0746	-26.9689	-26.6424	-24.1143	-20.0659	-15.0285	-9.1322	-6.7512	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-1.6311	-3.5775	-7.3956	-11.5453	-15.7102	-15.9518	-15.7648	-13.1410	-9.3663	-5.2538	-2.2200	-1.2793	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1550.3754	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												2755.8526	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												171.5393	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-323.5255	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												4240.2418	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1550.3754	0.2100	325.5788	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2755.8526	0.2100	578.7291	(264)
Space and water heating			904.3079	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	171.5393	0.1443	24.7584	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-220.6887	0.1326	-29.2744	
PV Unit electricity exported	-102.8368	0.1248	-12.8326	
Total			-42.1069	(269)
Total CO2, kg/year			898.8886	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.4800	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1550.3754	1.1300	1751.9242	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2755.8526	1.1300	3114.1135	(278)
Space and water heating			4866.0377	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	171.5393	1.5338	263.1127	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-220.6887	1.4901	-328.8571	
PV Unit electricity exported	-102.8368	0.4580	-47.0988	
Total			-375.9559	(283)
Total Primary energy kWh/year			4883.2953	(286)
Target Primary Energy Rate (TPER)			67.8200	(287)

Full SAP Calculation Printout

elmhurst energy

Property Reference	L02.02 x1_Copy_Copy	Issued on Date	12/09/2023
Assessment Reference	L02.02 x1_Copy_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	1.70	TER	10.15
Environmental	98 A	% DER < TER			83.25
CO_2 Emissions (t/year)	0.17	DFEE	23.27	TFEE	30.66
Compliance Check	See BREL	% DFEE < TFEE			24.11
% DPER < TPER	67.78	DPER	17.36	TPER	53.88

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		61.9000 (1b)	x	2.5000 (2b)	=	154.7500 (1b)	-
First floor		61.8000 (1c)	x	2.9500 (2c)	=	182.3100 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	123.7000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	337.0600	(5)

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80	=	0.0000 (6a)
Number of open flues	0 * 20	=	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10	=	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20	=	0.0000 (6d)
Number of flues attached to other heater	0 * 35	=	0.0000 (6e)
Number of blocked chimneys	0 * 20	=	0.0000 (6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			3.0000 (17)
Infiltration rate			0.1500 (18)
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1388 (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	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	43.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.4619	0.4584	0.4550	0.4376	0.4342	0.4168	0.4168	0.4133	0.4238	0.4342	0.4411	0.4480	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 0.80)			23.5000	0.7752	18.2171			(27)
External Wall 1	127.4340	23.5000	103.9340	0.1300	13.5114	190.0000	19747.4600	(29a)
External Roof 1	8.0000		8.0000	0.1000	0.8000	9.0000	72.0000	(30)
Total net area of external elements Aum(A, m2)			135.4340					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.5285			(33)
Party Wall 1			67.3000	0.0000	0.0000	180.0000	12114.0000	(32)
Party Floor 1			61.9000			40.0000	2476.0000	(32d)
Party Ceiling 1			53.8000			30.0000	1614.0000	(32b)
Internal Wall 1			221.5800			9.0000	1994.2200	(32c)
Internal Floor 1			61.8000			18.0000	1112.4000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	39130.0800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		316.3305 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	17.1500	0.0500	0.8575
E3 Sill	15.5700	0.0500	0.7785
E4 Jamb	33.5200	0.0500	1.6760
E6 Intermediate floor within a dwelling	23.5000	0.0000	0.0000
E16 Corner (normal)	16.2000	0.0900	1.4580
E18 Party wall between dwellings	10.8000	0.0600	0.6480
E7 Party floor between dwellings (in blocks of flats)	36.1000	0.0700	2.5270
E24 Eaves (insulation at ceiling level - inverted)	4.1000	0.1500	0.6150
E14 Flat roof	8.1000	0.0800	0.6480

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.2080 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	41.7365 (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	51.3777	50.9919	50.6061	48.6769	48.2911	46.3620	46.3620	45.9761	47.1336	48.2911	49.0628	49.8344	(38)
Heat transfer coeff	93.1142	92.7284	92.3426	90.4134	90.0276	88.0984	88.0984	87.7126	88.8701	90.0276	90.7992	91.5709	(39)
Average = Sum(39)m / 12 =												90.3170	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7527	0.7496	0.7465	0.7309	0.7278	0.7122	0.7122	0.7091	0.7184	0.7278	0.7340	0.7403	(40)
HLP (average)												0.7301	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8765 (42)

Hot water usage for mixer showers

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	99.6188	98.1217	95.9402	91.7662	88.6859	85.2508	83.2983	85.4634	87.8366	91.5249	95.7885	99.2371	(42a)

Hot water usage for baths

	31.2791	30.8146	30.1604	28.9542	28.0511	27.0496	26.5087	27.1583	27.8655	28.9372	30.1682	31.1734	(42b)

Hot water usage for other uses

	44.0887	42.4855	40.8823	39.2790	37.6758	36.0726	36.0726	37.6758	39.2790	40.8823	42.4855	44.0887	(42c)

Average daily hot water use (litres/day)	160.9265 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	174.9867	171.4218	166.9829	159.9995	154.4128	148.3730	145.8796	150.2974	154.9812	161.3443	168.4422	174.4992	(44)
Energy conte	277.1361	244.1024	256.6465	219.0313	207.8694	182.4420	176.4287	186.0996	191.1073	218.9427	239.9767	273.2236	(45)
Energy content (annual)											Total = Sum(45)m =	2673.0063	
Distribution loss (46)m = 0.15 x (45)m	41.5704	36.6154	38.4970	32.8547	31.1804	27.3663	26.4643	27.9149	28.6661	32.8414	35.9965	40.9835	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	332.4129	294.0298	311.9233	272.5250	263.1462	235.9356	231.7055	241.3764	244.6010	274.2195	293.4704	328.5004	(62)
WWHRS	-75.5667	-66.8318	-69.9824	-57.9482	-54.0057	-46.2130	-43.3174	-46.0637	-47.8138	-56.3672	-63.8572	-74.1673	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	256.8462	227.1980	241.9408	214.5768	209.1405	189.7226	188.3882	195.3127	196.7872	217.8523	229.6132	254.3331	(64)
											Total per year (kWh/year) = Sum(64)m =	2621.7116	(64)
12Total per year (kWh/year)												2622	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)

Heat gains from water heating, kWh/month	136.3692	121.1060	129.5564	115.6229	113.3380	103.4569	102.8840	106.0996	106.3381	117.0199	122.5872	135.0683	(65)

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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	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	148.1891	164.0665	148.1891	153.1287	148.1891	153.1287	148.1891	148.1891	153.1287	148.1891	153.1287	148.1891	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	289.9549	292.9638	285.3816	269.2401	248.8644	229.7141	216.9205	213.9117	221.4939	237.6353	258.0111	277.1614	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	(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)													
	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	(71)
Water heating gains (Table 5)													
	183.2919	180.2172	174.1349	160.5873	152.3360	143.6901	138.2849	142.6069	147.6918	157.2848	170.2600	181.5434	(72)
Total internal gains													
	687.5842	703.3957	673.8539	649.1044	615.5377	592.6812	569.5428	570.8559	588.4626	609.2574	647.5480	673.0421	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3000	10.6334	0.5000	0.8000	0.7700	12.6746	(74)
Southeast	5.7500	36.7938	0.5000	0.8000	0.7700	58.6457	(77)
South	6.3000	46.7521	0.5000	0.8000	0.7700	81.6459	(78)
West	7.1500	19.6403	0.5000	0.8000	0.7700	38.9266	(80)

Solar gains	191.8928	333.9808	473.5751	610.8722	703.5031	706.1699	677.6496	607.8365	521.2642	373.8195	231.1949	163.3156	(83)
Total gains	879.4770	1037.3765	1147.4289	1259.9766	1319.0408	1298.8511	1247.1923	1178.6924	1109.7269	983.0769	878.7429	836.3577	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	116.7326	117.2183	117.7081	120.2196	120.7348	123.3786	123.3786	123.9214	122.3073	120.7348	119.7088	118.7000	
alpha	8.7822	8.8146	8.8472	9.0146	9.0490	9.2252	9.2252	9.2614	9.1538	9.0490	8.9806	8.9133	
util living area													
	0.9971	0.9873	0.9533	0.8260	0.6309	0.4340	0.3108	0.3423	0.5515	0.8771	0.9879	0.9980	(86)
MIT	20.4833	20.6427	20.8130	20.9593	20.9961	20.9999	21.0000	21.0000	20.9991	20.9434	20.6989	20.4628	(87)
Th 2	20.2945	20.2972	20.2999	20.3136	20.3164	20.3301	20.3301	20.3328	20.3246	20.3164	20.3109	20.3054	(88)
util rest of house													
	0.9960	0.9829	0.9389	0.7907	0.5861	0.3886	0.2635	0.2927	0.4981	0.8404	0.9829	0.9972	(89)
MIT 2	19.6948	19.8980	20.1071	20.2786	20.3138	20.3300	20.3301	20.3328	20.3241	20.2687	19.9815	19.6777	(90)
Living area fraction									fLA = Living area / (4) =			0.2211	(91)
MIT	19.8691	20.0626	20.2632	20.4291	20.4646	20.4781	20.4782	20.4803	20.4733	20.4179	20.1402	19.8513	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8691	20.0626	20.2632	20.4291	20.4646	20.4781	20.4782	20.4803	20.4733	20.4179	20.1402	19.8513	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9811	0.9380	0.7969	0.5959	0.3987	0.2739	0.3036	0.5099	0.8463	0.9813	0.9966	(94)
Useful gains	875.1513	1017.7379	1076.3024	1004.0512	786.0089	517.7898	341.6611	357.8926	565.8116	832.0020	862.3397	833.4798	(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													
	1449.7081	1406.0071	1270.9281	1042.3826	789.0592	517.8542	341.6627	357.8966	566.4000	883.8812	1184.0366	1433.2022	(97)
Space heating kWh													
	427.4702	260.9169	144.8015	27.5986	2.2694	0.0000	0.0000	0.0000	0.0000	38.5981	231.6217	446.1935	(98a)
Space heating requirement - total per year (kWh/year)												1579.4699	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	427.4702	260.9169	144.8015	27.5986	2.2694	0.0000	0.0000	0.0000	0.0000	38.5981	231.6217	446.1935	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1579.4699	
Space heating per m2											(98c) / (4) =	12.7686	(99)

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 Heat pump-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.1000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		

	427.4702	260.9169	144.8015	27.5986	2.2694	0.0000	0.0000	0.0000	0.0000	38.5981	231.6217	446.1935	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10													
307a	470.2172	287.0086	159.2816	30.3585	2.4963	0.0000	0.0000	0.0000	0.0000	42.4579	254.7839	490.8128	
Space heating requirement													
	470.2172	287.0086	159.2816	30.3585	2.4963	0.0000	0.0000	0.0000	0.0000	42.4579	254.7839	490.8128	(307)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement													
	256.8462	227.1980	241.9408	214.5768	209.1405	189.7226	188.3882	195.3127	196.7872	217.8523	229.6132	254.3331	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10													
310a	282.5308	249.9178	266.1349	236.0345	230.0545	208.6949	207.2270	214.8440	216.4659	239.6375	252.5746	279.7664	
Water heating fuel													
	282.5308	249.9178	266.1349	236.0345	230.0545	208.6949	207.2270	214.8440	216.4659	239.6375	252.5746	279.7664	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	33.1787	29.9679	33.1787	32.1084	33.1787	32.1084	33.1787	33.1787	32.1084	33.1787	32.1084	33.1787	(331)
Lighting	27.2245	21.8405	19.6649	14.4074	11.1287	9.0922	10.1519	13.1959	17.1401	22.4888	25.4010	27.9811	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	-26.0461	-41.8579	-69.2042	-87.3847	-100.9413	-96.6488	-95.0072	-85.8801	-70.3875	-51.3888	-30.0738	-21.7541	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)
Annual totals kWh/year													
Space heating fuel - community heating												1737.4168	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												2883.8827	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												17.3742	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500)													
mechanical ventilation fans (SFP = 0.9500)												390.6525	(330a)
Total electricity for the above, kWh/year												390.6525	(331)
Electricity for lighting (calculated in Appendix L)												219.7170	(332)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-776.5747	(333)
Wind generation												0.0000	(334)
Hydro-electric generation (Appendix N)												0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(335)
Appendix Q - special features													
Energy saved or generated												-0.0000	(336)
Energy used												0.0000	(337)
Total delivered energy for all uses												4455.0944	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			310.0000	(367)
Space and Water heating from Heat pump	1490.7418	0.1588	88.9861	(367)
Electrical energy for heat distribution (space & water)	17.3742	0.0000	6.8158	(372)
Overall CO2 factor for heat network			0.0491	(386)
Total CO2 associated with community systems			226.6814	(373)
Space and water heating			226.6814	(376)
Pumps, fans and electric keep-hot	390.6525	0.1387	54.1883	(378)
Energy for lighting	219.7170	0.1443	31.7120	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-776.5747	0.1323	-102.7768	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-102.7768	(380)
Total CO2, kg/year			209.8049	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.7000	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			310.0000	(467a)
Space and Water heating from Heat pump	1490.7418	1.5877	889.8324	(467)
Electrical energy for heat distribution (space & water)	17.3742	0.0000	71.4256	(472)
Overall CO2 factor for heat network			0.5140	(486)
Total CO2 associated with community systems			2375.4777	(473)
Space and water heating			2375.4777	(476)
Pumps, fans and electric keep-hot	390.6525	1.5128	590.9792	(478)
Energy for lighting	219.7170	1.5338	337.0093	(479)

Energy saving/generation technologies

PV Unit electricity used in dwelling	-776.5747	1.4890	-1156.3247
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1156.3247 (480)
Total Primary energy kWh/year			2147.1415 (483)
Dwelling Primary energy Rate (DPER)			17.3600 (484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

			Area (m2)		Storey height (m)		Volume (m3)	
Ground floor			61.9000 (1b)	x	2.5000 (2b)	=	154.7500 (1b)	-
First floor			61.8000 (1c)	x	2.9500 (2c)	=	182.3100 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	123.7000						(4)	
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	337.0600 (5)	

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1187	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3687	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3410	(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	0.4348	0.4263	0.4178	0.3751	0.3666	0.3240	0.3240	0.3154	0.3410	0.3666	0.3837	0.4007	(22b)
Effective ac	0.5945	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5581	0.5672	0.5736	0.5803	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			23.5000	1.1450	26.9084			(27)
External Wall 1	127.4340	23.5000	103.9340	0.1800	18.7081			(29a)
External Roof 1	8.0000		8.0000	0.1100	0.8800			(30)
Total net area of external elements Aum(A, m2)			135.4340					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.4965			(33)
Party Wall 1			67.3000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 320.6797 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	17.1500	0.0500	0.8575
E3 Sill	15.5700	0.0500	0.7785
E4 Jamb	33.5200	0.0500	1.6760
E6 Intermediate floor within a dwelling	23.5000	0.0000	0.0000
E16 Corner (normal)	16.2000	0.0900	1.4580
E18 Party wall between dwellings	10.8000	0.0600	0.6480
E7 Party floor between dwellings (in blocks of flats)	36.1000	0.0700	2.5270
E24 Eaves (insulation at ceiling level - inverted)	4.1000	0.2400	0.9840
E14 Flat roof	8.1000	0.0800	0.6480

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5770 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 56.0735 (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	66.1291	65.7209	65.3207	63.4410	63.0893	61.4521	61.4521	61.1489	62.0827	63.0893	63.8007	64.5445	(38)
Heat transfer coeff	122.2027	121.7944	121.3942	119.5145	119.1628	117.5256	117.5256	117.2224	118.1562	119.1628	119.8743	120.6180	(39)
Average = Sum(39)m / 12 =												119.5128	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9879	0.9846	0.9814	0.9662	0.9633	0.9501	0.9501	0.9476	0.9552	0.9633	0.9691	0.9751	(40)
HLP (average)												0.9662	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8765 (42)
Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
72.4501	71.3613	69.7747	66.7391	64.4989	62.0006	60.5806	62.1552	63.8812	66.5636	69.6644	72.1725	(42a)

Hot water usage for baths

31.2791	30.8146	30.1604	28.9542	28.0511	27.0496	26.5087	27.1583	27.8655	28.9372	30.1682	31.1734	(42b)

Hot water usage for other uses

44.0887	42.4855	40.8823	39.2790	37.6758	36.0726	36.0726	37.6758	39.2790	40.8823	42.4855	44.0887	(42c)

Average daily hot water use (litres/day) 135.8778 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.8179	144.6613	140.8174	134.9724	130.2258	125.1228	123.1619	126.9892	131.0258	136.3830	142.3180	147.4346	(44)
Energy conte	234.1074	205.9958	216.4311	184.7704	175.3089	153.8531	148.9536	157.2392	161.5679	185.0704	202.7581	230.8469	(45)
Energy content (annual)											Total = Sum(45)m =	2256.9027	
Distribution loss (46)m = 0.15 x (45)m	35.1161	30.8994	32.4647	27.7156	26.2963	23.0780	22.3430	23.5859	24.2352	27.7606	30.4137	34.6270	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	283.3501	250.4731	265.6737	232.4246	224.5516	201.5073	198.1963	206.4819	209.2221	234.3131	250.4123	280.0895	(62)
WWHRS	-33.1211	-29.2926	-30.6735	-25.3989	-23.6709	-20.2553	-18.9861	-20.1899	-20.9569	-24.7059	-27.9888	-32.5078	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	250.2289	221.1805	235.0002	207.0257	200.8807	181.2520	179.2101	186.2920	188.2651	209.6071	222.4235	247.5818	(64)
											Total per year (kWh/year) = Sum(64)m =	2528.9476	(64)
12Total per year (kWh/year)												2529	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	117.2348	104.0754	111.3575	99.5595	97.6843	89.2795	88.9212	91.6762	91.8447	100.9300	105.5404	116.1507	(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	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	143.8273	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.1891	164.0665	148.1891	153.1287	148.1891	153.1287	148.1891	148.1891	153.1287	148.1891	153.1287	148.1891	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	289.9549	292.9638	285.3816	269.2401	248.8644	229.7141	216.9205	213.9117	221.4939	237.6353	258.0111	277.1614	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	37.3827	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	-115.0619	(71)
Water heating gains (Table 5)	157.5737	154.8741	149.6740	138.2771	131.2962	123.9993	119.5177	123.2207	127.5620	135.6587	146.5839	156.1166	(72)
Total internal gains	664.8660	681.0526	652.3929	629.7942	597.4979	572.9904	550.7756	551.4697	568.3328	590.6313	626.8719	650.6152	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W

					W/m2	or Table 6b	or Table 6c		Table 6d				
North					4.3000	10.6334	0.6300	0.7000	0.7700			13.9737	(74)
Southeast					5.7500	36.7938	0.6300	0.7000	0.7700			64.6569	(77)
South					6.3000	46.7521	0.6300	0.7000	0.7700			90.0146	(78)
West					7.1500	19.6403	0.6300	0.7000	0.7700			42.9166	(80)
Solar gains	211.5618	368.2138	522.1165	673.4866	775.6121	778.5523	747.1087	670.1397	574.6938	412.1360	254.8924	180.0554	(83)
Total gains	876.4278	1049.2664	1174.5095	1303.2808	1373.1100	1351.5427	1297.8842	1221.6094	1143.0267	1002.7673	881.7643	830.6707	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	90.1692	90.4714	90.7697	92.1973	92.4694	93.7575	93.7575	94.0000	93.2571	92.4694	91.9206	91.3537	
alpha	7.0113	7.0314	7.0513	7.1465	7.1646	7.2505	7.2505	7.2667	7.2171	7.1646	7.1280	7.0902	
util living area													
	0.9985	0.9942	0.9800	0.9178	0.7665	0.5530	0.3981	0.4408	0.6942	0.9491	0.9949	0.9989	(86)
MIT	20.1539	20.3336	20.5574	20.8180	20.9594	20.9965	20.9997	20.9994	20.9841	20.7905	20.4257	20.1298	(87)
Th 2	20.0934	20.0962	20.0989	20.1116	20.1140	20.1251	20.1251	20.1272	20.1208	20.1140	20.1092	20.1041	(88)
util rest of house													
	0.9978	0.9919	0.9720	0.8891	0.7078	0.4792	0.3192	0.3575	0.6146	0.9243	0.9925	0.9985	(89)
MIT 2	19.1104	19.3414	19.6242	19.9423	20.0852	20.1236	20.1251	20.1270	20.1125	19.9206	19.4700	19.0880	(90)
Living area fraction									fLA = Living area / (4) =			0.2211	(91)
MIT	19.3412	19.5608	19.8306	20.1359	20.2785	20.3166	20.3185	20.3199	20.3052	20.1129	19.6813	19.3184	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3412	19.5608	19.8306	20.1359	20.2785	20.3166	20.3185	20.3199	20.3052	20.1129	19.6813	19.3184	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9900	0.9690	0.8900	0.7192	0.4955	0.3366	0.3760	0.6319	0.9242	0.9908	0.9979	(94)
Useful gains	873.8729	1038.8253	1138.1448	1159.8655	987.5866	669.7108	436.9051	459.2685	722.2318	926.7745	873.6772	828.9531	(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	1838.0693	1785.5999	1618.2514	1342.8500	1022.2387	671.8446	437.0134	459.5039	733.1824	1133.5869	1508.1742	1823.5472	(97)
Space heating kWh	717.3621	501.8325	357.1993	131.7488	25.7811	0.0000	0.0000	0.0000	0.0000	153.8684	456.8378	739.9780	(98a)
Space heating requirement - total per year (kWh/year)												3084.6082	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	717.3621	501.8325	357.1993	131.7488	25.7811	0.0000	0.0000	0.0000	0.0000	153.8684	456.8378	739.9780	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3084.6082	
Space heating per m2											(98c) / (4) =	24.9362	(99)

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 %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	717.3621	501.8325	357.1993	131.7488	25.7811	0.0000	0.0000	0.0000	0.0000	153.8684	456.8378	739.9780	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	777.2071	543.6972	386.9982	142.7398	27.9319	0.0000	0.0000	0.0000	0.0000	166.7047	494.9488	801.7097	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	250.2289	221.1805	235.0002	207.0257	200.8807	181.2520	179.2101	186.2920	188.2651	209.6071	222.4235	247.5818	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.2834	85.8384	84.9960	83.0744	80.7307	79.8000	79.8000	79.8000	79.8000	83.3773	85.6374	86.3583	(217)
Fuel for water heating, kWh/month													
	290.0082	257.6707	276.4838	249.2052	248.8283	227.1328	224.5741	233.4486	235.9212	251.3960	259.7271	286.6915	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	30.7908	24.7015	22.2410	16.2947	12.5865	10.2833	11.4818	14.9245	19.3854	25.4347	28.7285	31.6465	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-22.7675	-34.1021	-52.0309	-62.1943	-70.3078	-66.7813	-65.9338	-60.6102	-51.8368	-40.5555	-25.7209	-19.4549	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-7.4194	-16.0179	-32.6292	-50.2083	-67.6041	-68.4090	-67.6393	-56.7353	-40.8678	-23.3288	-10.0357	-5.8393	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												3341.9374	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3041.0874	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												248.4991	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1019.0304	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												5698.4935	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3341.9374	0.2100	701.8068	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3041.0874	0.2100	638.6283	(264)
Space and water heating			1340.4352	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	248.4991	0.1443	35.8661	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-572.2961	0.1334	-76.3180	
PV Unit electricity exported	-446.7343	0.1252	-55.9223	
Total			-132.2403	(269)
Total CO2, kg/year			1255.9903	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.1500	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3341.9374	1.1300	3776.3892	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3041.0874	1.1300	3436.4287	(278)
Space and water heating			7212.8180	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	248.4991	1.5338	381.1562	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-572.2961	1.4928	-854.3143	
PV Unit electricity exported	-446.7343	0.4595	-205.2573	
Total			-1059.5715	(283)
Total Primary energy kWh/year			6664.5035	(286)
Target Primary Energy Rate (TPER)			53.8800	(287)

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Property Reference	L07-9.03 MA x3_Copy	Issued on Date	12/09/2023
Assessment Reference	L07-9.03 MA x3_Copy	Prop Type Ref	
Property			

SAP Rating	87 B	DER	2.53	TER	12.80
Environmental	98 A	% DER < TER			80.23
CO_2 Emissions (t/year)	0.16	DFEE	29.07	TFEE	29.40
Compliance Check	See BREL	% DFEE < TFEE			1.13
% DPER < TPER	61.33	DPER	26.88	TPER	69.50

Assessor Details	Mr. Richard Denteh	Assessor ID	U148-0001
Client			

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.2000 (1b)	x	2.7400 (2b)	=	197.8280 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8280	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			3.0000	(17)
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 exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	72.8000	(23c)

Effective ac	0.2986	0.2954	0.2922	0.2762	0.2731	0.2571	0.2571	0.2539	0.2635	0.2731	0.2794	0.2858	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.30)			15.4300	1.2357	19.0675			(27)
External Wall 1	56.1426	15.4300	40.7126	0.1400	5.6998	190.0000	7735.3940	(29a)
Total net area of external elements Aum(A, m2)			56.1426					(31)

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Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	24.7673	(33)
Party Wall 1	56.0900	0.0000	0.0000	180.0000	10096.2000 (32)
Party Floor 1	72.2000			40.0000	2888.0000 (32d)
Party Ceiling 1	72.2000			30.0000	2166.0000 (32b)
Internal Wall 1	80.8300			75.0000	6062.2500 (32c)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =		28947.8440 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					400.9397 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	9.4800	0.0300	0.2844
E3 Sill	7.9000	0.0300	0.2370
E4 Jamb	17.0400	0.0300	0.5112
E7 Party floor between dwellings (in blocks of flats)	40.9800	0.0700	2.8686
E18 Party wall between dwellings	5.4800	0.0600	0.3288
E16 Corner (normal)	5.4800	0.0900	0.4932
E8 Balcony within a dwelling, wall insulation continuous	5.8400	0.0000	0.0000
E17 Corner (inverted - internal area greater than external area)	2.7400	-0.0900	-0.2466

Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.4766 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	29.2439 (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	19.4911	19.2830	19.0749	18.0345	17.8264	16.7860	16.7860	16.5779	17.2021	17.8264	18.2426	18.6588	(38)
Heat transfer coeff	48.7350	48.5269	48.3188	47.2783	47.0703	46.0298	46.0298	45.8217	46.4460	47.0703	47.4864	47.9026	(39)
Average = Sum(39)m / 12 =												47.2263	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.6750	0.6721	0.6692	0.6548	0.6519	0.6375	0.6375	0.6346	0.6433	0.6519	0.6577	0.6635	(40)
HLP (average)												0.6541	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2983	(42)
Hot water usage for mixer showers	86.2882	84.9915	83.1019	79.4865	76.8184	73.8429	72.1517	74.0270	76.0827	79.2774	82.9705	85.9576	(42a)
Hot water usage for baths	27.1100	26.7073	26.1404	25.0950	24.3122	23.4442	22.9754	23.5384	24.1514	25.0802	26.1471	27.0183	(42b)
Hot water usage for other uses	38.1672	36.7793	35.3914	34.0035	32.6156	31.2277	31.2277	32.6156	34.0035	35.3914	36.7793	38.1672	(42c)
Average daily hot water use (litres/day)												139.3875	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.5654	148.4781	144.6336	138.5849	133.7461	128.5148	126.3547	130.1810	134.2376	139.7489	145.8968	151.1431	(44)
Energy conte	240.0425	211.4309	222.2965	189.7158	180.0480	158.0240	152.8151	161.1912	165.5283	189.6380	207.8568	236.6536	(45)
Energy content (annual)										Total = Sum(45)m =		2315.2407	
Distribution loss (46)m = 0.15 x (45)m	36.0064	31.7146	33.3445	28.4574	27.0072	23.7036	22.9223	24.1787	24.8292	28.4457	31.1785	35.4980	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5200	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												0.9120	(55)
Total storage loss	28.2720	25.5360	28.2720	27.3600	28.2720	27.3600	28.2720	28.2720	27.3600	28.2720	27.3600	28.2720	(56)
If cylinder contains dedicated solar storage	28.2720	25.5360	28.2720	27.3600	28.2720	27.3600	28.2720	28.2720	27.3600	28.2720	27.3600	28.2720	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	291.5769	257.9781	273.8309	239.5878	231.5824	207.8960	204.3495	212.7256	215.4003	241.1724	257.7288	288.1880	(62)
WWHRS	-65.4547	-57.8887	-60.6177	-50.1938	-46.7788	-40.0290	-37.5208	-39.8996	-41.4155	-48.8244	-55.3121	-64.2426	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	226.1222	200.0894	213.2132	189.3940	184.8036	167.8670	166.8287	172.8260	173.9848	192.3480	202.4167	223.9454	(64)
									Total per year (kWh/year) = Sum(64)m =			2313.8391	(64)
12Total per year (kWh/year)												2314	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	121.0417	107.5385	115.1411	102.9781	101.0935	92.4406	92.0385	94.8236	94.9358	104.2822	109.0100	119.9148	(65)

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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	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	102.0756	113.0123	102.0756	105.4781	102.0756	105.4781	102.0756	102.0756	105.4781	102.0756	105.4781	102.0756	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	202.3763	204.4763	199.1843	187.9182	173.6968	160.3307	151.4014	149.3013	154.5933	165.8594	180.0808	193.4469	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	(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	(70)
Losses e.g. evaporation (negative values) (Table 5)												
	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	(71)
Water heating gains (Table 5)												
	162.6904	160.0276	154.7596	143.0252	135.8783	128.3897	123.7077	127.4511	131.8552	140.1642	151.4028	161.1759 (72)
Total internal gains												
	524.6172	534.9911	513.4944	493.8964	469.1257	451.6735	434.6596	436.3029	449.4016	465.5741	494.4366	514.1733 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.3300	0.8000	0.7700	19.1622	(74)
East	5.5800	19.6403	0.3300	0.8000	0.7700	20.0502	(76)

Solar gains	39.2124	75.8424	126.8200	194.1574	250.0967	262.3267	247.0917	203.4184	149.9413	90.1320	48.6393	32.4629	(83)
Total gains	563.8296	610.8334	640.3144	688.0538	719.2224	714.0002	681.7513	639.7213	599.3429	555.7061	543.0759	546.6361	(84)

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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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	164.9958	165.7033	166.4170	170.0793	170.8312	174.6926	174.6926	175.4860	173.1273	170.8312	169.3340	167.8628	
alpha	11.9997	12.0469	12.0945	12.3386	12.3887	12.6462	12.6462	12.6991	12.5418	12.3887	12.2889	12.1909	
util living area													
	0.9962	0.9883	0.9581	0.8157	0.6081	0.4126	0.2971	0.3295	0.5346	0.8542	0.9826	0.9971	(86)
MIT	20.7308	20.8103	20.9069	20.9884	20.9996	21.0000	21.0000	21.0000	20.9999	20.9841	20.8647	20.7223	(87)
Th 2	20.3630	20.3655	20.3681	20.3809	20.3835	20.3963	20.3963	20.3989	20.3912	20.3835	20.3783	20.3732	(88)
util rest of house													
	0.9945	0.9833	0.9428	0.7796	0.5681	0.3737	0.2563	0.2864	0.4875	0.8136	0.9743	0.9958	(89)
MIT 2	20.0587	20.1601	20.2771	20.3721	20.3833	20.3963	20.3963	20.3989	20.3912	20.3720	20.2391	20.0571	(90)
Living area fraction										fLA = Living area / (4) =		0.3940	(91)
MIT	20.3235	20.4163	20.5253	20.6150	20.6261	20.6342	20.6342	20.6358	20.6310	20.6132	20.4856	20.3192	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3235	20.4163	20.5253	20.6150	20.6261	20.6342	20.6342	20.6358	20.6310	20.6132	20.4856	20.3192	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9838	0.9470	0.7935	0.5839	0.3890	0.2724	0.3034	0.5061	0.8293	0.9760	0.9956	(94)
Useful gains	560.6371	600.9094	606.3942	545.9990	419.9310	277.7523	185.6938	194.0902	303.3117	460.8680	530.0319	544.2425	(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													
	780.9065	752.9600	677.6843	553.8640	420.1551	277.7534	185.6938	194.0902	303.3410	471.3233	635.6357	772.1531	(97)
Space heating kWh													
	163.8804	102.1780	53.0398	5.6628	0.1667	0.0000	0.0000	0.0000	0.0000	7.7787	76.0347	169.5655	(98a)
Space heating requirement - total per year (kWh/year)												578.3069	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	163.8804	102.1780	53.0398	5.6628	0.1667	0.0000	0.0000	0.0000	0.0000	7.7787	76.0347	169.5655	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												578.3069	
Space heating per m2											(98c) / (4) =	8.0098	(99)

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 Heat pump-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.1000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating:		
Space heating requirement		
163.8804 102.1780 53.0398 5.6628 0.1667 0.0000 0.0000 0.0000 0.0000 7.7787 76.0347 169.5655		(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10		
307a 180.2685 112.3958 58.3438 6.2291 0.1834 0.0000 0.0000 0.0000 0.0000 8.5566 83.6382 186.5221		
Space heating requirement		
180.2685 112.3958 58.3438 6.2291 0.1834 0.0000 0.0000 0.0000 0.0000 8.5566 83.6382 186.5221		(307)
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 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(309)

Water heating		
Annual water heating requirement		
226.1222 200.0894 213.2132 189.3940 184.8036 167.8670 166.8287 172.8260 173.9848 192.3480 202.4167 223.9454		(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10		
310a 248.7344 220.0983 234.5346 208.3334 203.2839 184.6537 183.5116 190.1086 191.3833 211.5828 222.6584 246.3400		
Water heating fuel		
248.7344 220.0983 234.5346 208.3334 203.2839 184.6537 183.5116 190.1086 191.3833 211.5828 222.6584 246.3400		(310)
Cooling System Energy Efficiency Ratio	0.0000	(314)
Space coolin 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(315)
Pumps and Fa 12.8114 11.5716 12.8114 12.3981 12.8114 12.3981 12.8114 12.8114 12.3981 12.8114 12.3981 12.8114		(331)
Lighting 18.7528 15.0442 13.5456 9.9241 7.6656 6.2629 6.9929 9.0896 11.8065 15.4907 17.4967 19.2739		(332)
Electricity generated by PVs (Appendix M) (negative quantity)		
(333a)m -3.1381 -5.0274 -8.2217 -10.5650 -12.6329 -12.2688 -12.1089 -10.7766 -8.7127 -6.2565 -3.6543 -2.6467		(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)		
(334a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)		
(335a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(335a)
Electricity generated by PVs (Appendix M) (negative quantity)		
(333b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)		
(334b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)		
(335b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000		(335b)
Annual totals kWh/year		
Space heating fuel - community heating	636.1375	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	2545.2230	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	6.3614	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)		
mechanical ventilation fans (SFP = 0.6250)	150.8439	(330a)
Total electricity for the above, kWh/year	150.8439	(331)
Electricity for lighting (calculated in Appendix L)	151.3454	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-96.0095	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	3387.5403	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			310.0000	(367)
Space and Water heating from Heat pump	1026.2453	0.1594	32.7112	(367)
Electrical energy for heat distribution (space & water)	6.3614	0.0000	4.5939	(372)
Overall CO2 factor for heat network			0.0480	(386)
Total CO2 associated with community systems			152.7850	(373)
Space and water heating			152.7850	(376)
Pumps, fans and electric keep-hot	150.8439	0.1387	20.9239	(378)
Energy for lighting	151.3454	0.1443	21.8438	(379)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-96.0095	0.1320	-12.6725	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-12.6725	(380)
Total CO2, kg/year			182.8803	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.5300	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Heat pump			310.0000	(467a)
Space and Water heating from Heat pump	1026.2453	1.5900	326.2845	(467)
Electrical energy for heat distribution (space & water)	6.3614	0.0000	48.8038	(472)
Overall CO2 factor for heat network			0.5102	(486)
Total CO2 associated with community systems			1623.1204	(473)
Space and water heating			1623.1204	(476)
Pumps, fans and electric keep-hot	150.8439	1.5128	228.1966	(478)
Energy for lighting	151.3454	1.5338	232.1387	(479)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-96.0095	1.4877	-142.8304	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-142.8304	(480)
Total Primary energy kWh/year			1940.6252	(483)
Dwelling Primary energy Rate (DPER)			26.8800	(484)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.2000 (1b)	x	2.7400 (2b)	=	197.8280 (1b) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	197.8280	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys		0 * 80 =	0.0000	(6a)
Number of open flues		0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000	(6d)
Number of flues attached to other heater		0 * 35 =	0.0000	(6e)
Number of blocked chimneys		0 * 20 =	0.0000	(6f)
Number of intermittent extract 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)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1516	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.4016	(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) =	0.3414	(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													
	0.4353	0.4267	0.4182	0.3755	0.3670	0.3243	0.3243	0.3158	0.3414	0.3670	0.3841	0.4011	(22b)
Effective ac	0.5947	0.5911	0.5875	0.5705	0.5673	0.5526	0.5526	0.5499	0.5583	0.5673	0.5738	0.5805	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			15.4300	1.1450	17.6679			(27)
External Wall 1	56.1426	15.4300	40.7126	0.1800	7.3283			(29a)
Total net area of external elements Aum(A, m2)			56.1426					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.9962			(33)
Party Wall 1			56.0900	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K				410.9397	(35)
List of Thermal Bridges					
K1 Element	Length	Psi-value	Total		
E2 Other lintels (including other steel lintels)	9.4800	0.0500	0.4740		
E3 Sill	7.9000	0.0500	0.3950		
E4 Jamb	17.0400	0.0500	0.8520		
E7 Party floor between dwellings (in blocks of flats)	40.9800	0.0700	2.8686		
E18 Party wall between dwellings	5.4800	0.0600	0.3288		
E16 Corner (normal)	5.4800	0.0900	0.4932		
E8 Balcony within a dwelling, wall insulation continuous	5.8400	0.0000	0.0000		
E17 Corner (inverted – internal area greater than external area)	2.7400	-0.0900	-0.2466		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				5.1650	(36)
Point Thermal bridges			(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =	30.1612	(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	38.8263	38.5862	38.3508	37.2451	37.0382	36.0752	36.0752	35.8969	36.4461	37.0382	37.4567	37.8942	(38)
Heat transfer coeff													
	68.9875	68.7474	68.5120	67.4063	67.1994	66.2364	66.2364	66.0581	66.6073	67.1994	67.6179	68.0554	(39)
Average = Sum(39)m / 12 =												67.4053	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9555	0.9522	0.9489	0.9336	0.9307	0.9174	0.9174	0.9149	0.9225	0.9307	0.9365	0.9426	(40)
HLP (average)												0.9336	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2983	(42)
Hot water usage for mixer showers													
	62.7551	61.8120	60.4377	57.8083	55.8679	53.7039	52.4739	53.8378	55.3329	57.6563	60.3422	62.5146	(42a)
Hot water usage for baths													
	27.1100	26.7073	26.1404	25.0950	24.3122	23.4442	22.9754	23.5384	24.1514	25.0802	26.1471	27.0183	(42b)
Hot water usage for other uses													
	38.1672	36.7793	35.3914	34.0035	32.6156	31.2277	31.2277	32.6156	34.0035	35.3914	36.7793	38.1672	(42c)
Average daily hot water use (litres/day)												117.6907	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	128.0322	125.2986	121.9695	116.9068	112.7957	108.3758	106.6770	109.9918	113.4877	118.1278	123.2685	127.7001	(44)
Energy conte	202.7718	178.4236	187.4626	160.0395	151.8447	133.2607	129.0166	136.1928	139.9417	160.2984	175.6186	199.9476	(45)
Energy content (annual)											Total = Sum(45)m =	1954.8185	
Distribution loss (46)m = 0.15 x (45)m													
	30.4158	26.7635	28.1194	24.0059	22.7767	19.9891	19.3525	20.4289	20.9913	24.0448	26.3428	29.9921	(46)
Water storage loss:													
Store volume												180.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5520	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8381	(55)
Total storage loss													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(56)
If cylinder contains dedicated solar storage													
	25.9803	23.4661	25.9803	25.1422	25.9803	25.1422	25.9803	25.9803	25.1422	25.9803	25.1422	25.9803	(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)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	252.0144	222.9008	236.7052	207.6937	201.0873	180.9149	178.2593	185.4355	187.5959	209.5410	223.2728	249.1902	(62)
WWHRS	-28.6890	-25.3728	-26.5689	-22.0001	-20.5033	-17.5448	-16.4455	-17.4881	-18.1526	-21.3999	-24.2435	-28.1577	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
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	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	223.3254	197.5280	210.1363	185.6936	180.5840	163.3701	161.8138	167.9473	169.4434	188.1412	199.0294	221.0325	(64)
											Total per year (kWh/year) = Sum(64)m =	2268.0450	(64)
12Total per year (kWh/year)												2268	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month													
	106.8157	94.9076	101.7254	91.3365	89.8825	82.4326	82.2922	84.6782	84.6540	92.6933	96.5166	105.8767	(65)

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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	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	114.9164	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	102.2420	113.1965	102.2420	105.6501	102.2420	105.6501	102.2420	102.2420	105.6501	102.2420	105.6501	102.2420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	202.3763	204.4763	199.1843	187.9182	173.6968	160.3307	151.4014	149.3013	154.5933	165.8594	180.0808	193.4469	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	34.4916	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	-91.9332	(71)
Water heating gains (Table 5)													
	143.5695	141.2316	136.7277	126.8563	120.8098	114.4897	110.6077	113.8148	117.5750	124.5878	134.0508	142.3074	(72)
Total internal gains													
	508.6628	519.3794	498.6290	480.8995	457.2236	437.9454	421.7260	422.8331	435.2933	453.1642	480.2566	498.4712	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.8500	10.6334	0.6300	0.7000	0.7700	32.0096	(74)
East	5.5800	19.6403	0.6300	0.7000	0.7700	33.4929	(76)

Solar gains	65.5025	126.6912	211.8470	324.3312	417.7752	438.2049	412.7555	339.8012	250.4701	150.5614	81.2497	54.2277	(83)
Total gains	574.1653	646.0706	710.4760	805.2307	874.9987	876.1503	834.4815	762.6343	685.7635	603.7255	561.5063	552.6990	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	119.4654	119.8827	120.2947	122.2679	122.6443	124.4274	124.4274	124.7633	123.7345	122.6443	121.8852	121.1016	
alpha	8.9644	8.9922	9.0196	9.1512	9.1763	9.2952	9.2952	9.3176	9.2490	9.1763	9.1257	9.0734	
util living area													
	0.9990	0.9967	0.9857	0.9072	0.7046	0.4835	0.3492	0.3984	0.6646	0.9541	0.9963	0.9993	(86)
MIT	20.4171	20.5334	20.7044	20.9140	20.9915	20.9997	21.0000	21.0000	20.9962	20.8758	20.6158	20.4035	(87)
Th 2	20.1206	20.1234	20.1261	20.1390	20.1414	20.1527	20.1527	20.1548	20.1484	20.1414	20.1366	20.1314	(88)
util rest of house													
	0.9985	0.9950	0.9782	0.8718	0.6440	0.4197	0.2820	0.3252	0.5857	0.9266	0.9940	0.9989	(89)
MIT 2	19.4507	19.6011	19.8174	20.0670	20.1365	20.1526	20.1527	20.1548	20.1468	20.0354	19.7175	19.4423	(90)
Living area fraction									fLA = Living area / (4) =			0.3940	(91)
MIT	19.8315	19.9685	20.1669	20.4007	20.4734	20.4864	20.4866	20.4878	20.4815	20.3666	20.0714	19.8211	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8315	19.9685	20.1669	20.4007	20.4734	20.4864	20.4866	20.4878	20.4815	20.3666	20.0714	19.8211	(93)

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9946	0.9787	0.8835	0.6678	0.4449	0.3085	0.3541	0.6170	0.9350	0.9938	0.9987	(94)
Useful gains	573.1706	642.5555	695.3108	711.4282	584.3402	389.7799	257.4305	270.0241	423.1020	564.4624	558.0180	551.9962	(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													
	1071.4788	1035.9178	936.3486	775.2219	589.5694	389.8965	257.4336	270.0351	425.0536	656.3071	877.1015	1063.0992	(97)
Space heating kWh													
	370.7413	264.3395	179.3321	45.9314	3.8905	0.0000	0.0000	0.0000	0.0000	68.3325	229.7401	380.2606	(98a)
Space heating requirement - total per year (kWh/year)												1542.5681	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	370.7413	264.3395	179.3321	45.9314	3.8905	0.0000	0.0000	0.0000	0.0000	68.3325	229.7401	380.2606	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1542.5681	
Space heating per m2											(98c) / (4) =	21.3652	(99)

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 %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	370.7413	264.3395	179.3321	45.9314	3.8905	0.0000	0.0000	0.0000	0.0000	68.3325	229.7401	380.2606	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	401.6699	286.3917	194.2927	49.7632	4.2150	0.0000	0.0000	0.0000	0.0000	74.0330	248.9059	411.9834	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	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													
	223.3254	197.5280	210.1363	185.6936	180.5840	163.3701	161.8138	167.9473	169.4434	188.1412	199.0294	221.0325	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.1882	84.7139	83.7064	81.4367	79.9709	79.8000	79.8000	79.8000	79.8000	82.0147	84.3824	85.2651	(217)
Fuel for water heating, kWh/month													
	262.1553	233.1707	251.0398	228.0220	225.8121	204.7244	202.7742	210.4603	212.3350	229.3994	235.8659	259.2298	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	21.2439	17.0426	15.3450	11.2424	8.6840	7.0949	7.9218	10.2970	13.3748	17.5485	19.8210	21.8343	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-7.9741	-12.3677	-19.5340	-24.2038	-28.1474	-27.0385	-26.7111	-24.1766	-20.1180	-15.0681	-9.1566	-6.7694	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-1.6363	-3.5888	-7.4189	-11.5813	-15.7591	-16.0014	-15.8140	-13.1822	-9.3959	-5.2705	-2.2271	-1.2834	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1671.2547	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												2754.9890	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												171.4502	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-324.4242	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												4359.2697	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1671.2547	0.2100	350.9635	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2754.9890	0.2100	578.5477	(264)
Space and water heating			929.5112	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	171.4502	0.1443	24.7456	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-221.2652	0.1327	-29.3509	
PV Unit electricity exported	-103.1590	0.1248	-12.8728	
Total			-42.2238	(269)
Total CO2, kg/year			923.9622	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.8000	(273)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1671.2547	1.1300	1888.5178	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2754.9890	1.1300	3113.1375	(278)
Space and water heating			5001.6553	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	171.4502	1.5338	262.9761	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-221.2652	1.4901	-329.7166	
PV Unit electricity exported	-103.1590	0.4580	-47.2465	
Total			-376.9631	(283)
Total Primary energy kWh/year			5017.7691	(286)
Target Primary Energy Rate (TPER)			69.5000	(287)

Appendix A.3 – BRUKL Reports (Be Lean)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block F - Office - Be Clean

As designed

Date: Wed Aug 09 12:17:54 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 24.15

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	12.4	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	10.57	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	73.19	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	69.68	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	09000001:Surf[2]
Floors	0.18	0.1	0.1	09000001:Surf[3]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	0.8	0.8	09000001:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.8	0.8	09000001:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- System HN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
BF-04 Marketing Suite	-	-	-	-	-	-	-	0.3	-	-	N/A
Closing room	-	-	-	-	-	-	-	0.3	-	-	N/A
WC	-	-	-	-	-	-	-	0.3	-	-	N/A
Kitchennette	-	-	-	-	-	-	-	0.3	-	-	N/A
WC ACC.	-	-	-	-	-	-	-	0.3	-	-	N/A
WC	-	-	-	-	-	-	-	0.3	-	-	N/A
Cafe Offering	-	-	-	-	-	-	-	0.3	-	-	N/A
BF04 Marketing Suite	-	-	-	-	-	-	-	0.3	-	-	N/A
Shower	-	-	-	-	-	-	-	0.3	-	-	N/A
Shower lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
Resident Offices	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
BF-04 Marketing Suite	125	-	-
Closing room	125	-	-
WC	125	-	-
Kitchennette	125	-	-
WC ACC.	125	-	-
WC	125	-	-
Cafe Offering	125	-	-
BF04 Marketing Suite	125	-	-
Shower	125	-	-
Shower lobby	125	-	-
Resident Offices	125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
BF-04 Marketing Suite	NO (-14%)	NO
Closing room	N/A	N/A
WC	N/A	N/A
Kitchennette	N/A	N/A
WC ACC.	N/A	N/A
WC	N/A	N/A
Cafe Offering	YES (+32.7%)	NO
BF04 Marketing Suite	NO (-2.7%)	NO
Shower	N/A	N/A
Shower lobby	N/A	N/A
Resident Offices	NO (-36.1%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	289.8	289.8
External area [m²]	490.3	490.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	147.81	187.97
Average U-value [W/m²K]	0.3	0.38
Alpha value* [%]	9.99	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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	9.63	18.16
Cooling	7.04	2.1
Auxiliary	9.78	11.58
Lighting	3.88	8.47
Hot water	19.01	24.4
Equipment*	35.73	35.73
TOTAL**	**49.33**	**64.71**

* Energy used by equipment does not count towards the total for consumption or 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	2.74
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*2.74*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	113.41	94.12
Primary energy [kWh_{PE}/m²]	69.68	73.19
Total emissions [kg/m²]	10.57	12.4

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	31.1	82.3	9.6	7	9.8	0.9	3.25	1	3.92
	Notional	59.2	34.9	18.2	2.1	8.9	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block F - Resi Areas - Be Clean

As designed

Date: Fri Aug 04 17:16:56 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 5.81

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	7.74	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.4	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	60.88	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	50.12	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	0900000E:Surf[1]
Floors	0.18	0.1	0.1	0900000E:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1	1	0900000E:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- System HN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Circulation	-	-	-	-	-	-	-	0.3	-	-	N/A
Parcel	-	-	-	-	-	-	-	0.3	-	-	N/A
Security room	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m^2]
Standard value	95	80	0.3
Circulation	125	-	-
Parcel	125	-	-
Security room	125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Circulation	N/A	N/A
Parcel	N/A	N/A
Security room	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	69.7	69.7
External area [m^2]	118.3	118.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	18.52	41.81
Average U-value [W/m^2K]	0.16	0.35
Alpha value* [%]	10	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	4.67	15.17
Cooling	3.9	3.25
Auxiliary	11.65	16.45
Lighting	12.62	12.88
Hot water	1.1	1.07
Equipment*	39.86	39.86
TOTAL**	**33.94**	**48.83**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	2.74
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*2.74*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	60.62	103.72
Primary energy [kWh_{PE}/m^2]	50.12	60.88
Total emissions [kg/m^2]	5.4	7.74

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity									
Actual	15.1	45.6	4.7	3.9	11.7	0.9	3.25	1	3.92
Notional	49.5	54.3	15.2	3.3	16.4	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block F - Retail - Be Clean

As designed

Date: Wed Aug 09 13:37:28 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 16.1

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	7.81	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	6.86	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	58.21	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	57.44	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	09000000:Surf[2]
Floors	0.18	0.1	0.1	09000000:Surf[3]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	0.8	0.8	09000000:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.8	0.8	09000000:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- System HN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
BF02 Retail	-	-	-	-	-	-	-	0.3	-	-	N/A
BF01 Retail	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m^2]
Standard value	95	80	0.3
BF02 Retail	125	100	1.2
BF01 Retail	125	100	1.2

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
BF02 Retail	YES (+6.6%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
BF01 Retail	NO (-10.2%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	193.2	193.2
External area [m^2]	354.3	354.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	117.8	145.75
Average U-value [W/m^2K]	0.33	0.41
Alpha value* [%]	9.99	10

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	9.41	16.55
Cooling	8.58	2.36
Auxiliary	13.44	12.26
Lighting	6.13	14.5
Hot water	1.93	1.87
Equipment*	20.25	20.25
TOTAL**	**39.49**	**47.55**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	2.74
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*2.74*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	130.74	93.29
Primary energy [kWh_{PE}/m^2]	57.44	58.21
Total emissions [kg/m^2]	6.86	7.81

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity									
Actual	30.4	100.4	9.4	8.6	13.4	0.9	3.25	1	3.92
Notional	53.9	39.4	16.5	2.4	12.3	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block H - Resi areas - Be Clean

As built

Date: Thu Aug 10 08:35:11 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 21.03

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	8.97	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	6.98	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	66.23	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	62.03	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	BL000007:Surf[2]
Floors	0.18	0.1	0.1	BL000007:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	0.8	0.8	BL000007:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.8	0.8	BL000007:Surf[5]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A
CORRIDOR	-	-	-	-	-	-	-	0.3	-	-	N/A
LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A
CORRIDOR	-	-	-	-	-	-	-	0.3	-	-	N/A
LOBBY & POST	-	-	-	-	-	-	-	0.3	-	-	N/A
LOBBY & POST	-	-	-	-	-	-	-	0.3	-	-	N/A
LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A
LOBBY	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m^2]**
Standard value	95	80	0.3
LOBBY	125	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
CORRIDOR	125	-	-
LOBBY	125	-	-
CORRIDOR	125	-	-
LOBBY & POST	125	-	-
LOBBY & POST	125	-	-
LOBBY	125	-	-
LOBBY	125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
LOBBY	NO (-44.5%)	NO
CORRIDOR	N/A	N/A
LOBBY	NO (-12.7%)	NO
CORRIDOR	N/A	N/A
LOBBY & POST	YES (+4.5%)	NO
LOBBY & POST	YES (+7.5%)	NO
LOBBY	N/A	N/A
LOBBY	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	168.3	168.3
External area [m²]	286.9	286.9
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	82.95	110.41
Average U-value [W/m²K]	0.29	0.38
Alpha value* [%]	9.99	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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	9.26	19.52
Cooling	7.15	2.64
Auxiliary	17.79	16.23
Lighting	8.07	12.31
Hot water	0	0
Equipment*	48.62	48.62
TOTAL**	**42.27**	**50.71**

* Energy used by equipment does not count towards the total for consumption or 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	4.11
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*4.11*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	113.31	107.69
Primary energy [kWh_{PE}/m²]	62.03	66.23
Total emissions [kg/m²]	6.98	8.97

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity									
Actual	29.8	83.5	9.3	7.1	17.8	0.89	3.24	1	3.92
Notional	63.6	44.1	19.5	2.6	16.2	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block H - retail - Be Clean

As built

Date: Wed Aug 09 14:07:47 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 101.2

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	9.14	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	6.86	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	67.15	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	57.91	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	BL000003:Surf[5]
Floors	0.18	0.1	0.1	BL000003:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	0.8	0.8	BL000003:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.8	0.8	BL000003:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
RETAIL BH3 - 01	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH3 - 02	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH3 - 03	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH3 - 04	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 01	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 02	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 03	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 04	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 05	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 06	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 06	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 05	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 04	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
RETAIL BH2 - 01	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 03	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 02	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BOH	-	-	-	-	-	-	-	0.3	-	-	N/A
WC & SHOWER	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
RETAIL BH3 - 01	125	100	1.5
RETAIL BH3 - 02	125	100	1.5
RETAIL BH3 - 03	125	100	1.5
RETAIL BH3 - 04	125	100	1.5
RETAIL BH2 - 01	125	100	1.5
RETAIL BH2 - 02	125	100	1.5
RETAIL BH2 - 03	125	100	1.5
RETAIL BH2 - 04	125	100	1.5
RETAIL BH2 - 05	125	100	1.5
RETAIL BH2 - 06	125	100	1.5
RETAIL BH2 - 06	125	100	1.5
RETAIL BH2 - 05	125	100	1.5
RETAIL BH2 - 04	125	100	1.5
RETAIL BH2 - 05	125	100	1.5
RETAIL BH2 - 04	125	100	1.5
RETAIL BH2 - 01	125	100	1.5
RETAIL BH2 - 03	125	100	1.5
RETAIL BH2 - 02	125	100	1.5
RETAIL BOH	125	-	-
WC & SHOWER	125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
RETAIL BH3 - 01	NO (-62%)	NO
RETAIL BH3 - 02	NO (-52.4%)	NO
RETAIL BH3 - 03	NO (-44.3%)	NO
RETAIL BH3 - 04	NO (-47.5%)	NO
RETAIL BH2 - 01	NO (-43.9%)	NO
RETAIL BH2 - 02	NO (-14.3%)	NO
RETAIL BH2 - 03	NO (-23.2%)	NO
RETAIL BH2 - 04	NO (-48.4%)	NO
RETAIL BH2 - 05	YES (+14.3%)	NO
RETAIL BH2 - 06	NO (-31.9%)	NO
RETAIL BH2 - 06	NO (-31.9%)	NO
RETAIL BH2 - 05	NO (-9.6%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
RETAIL BH2 - 04	NO (-37.3%)	NO
RETAIL BH2 - 01	NO (-43.9%)	NO
RETAIL BH2 - 03	NO (-25.7%)	NO
RETAIL BH2 - 02	NO (-14.6%)	NO
RETAIL BOH	NO (-52.1%)	NO
WC & SHOWER	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	809.6	809.6
External area [m^2]	1526.3	1526.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	431.71	620.95
Average U-value [W/m^2K]	0.28	0.41
Alpha value* [%]	9.99	10

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	8.84	18.04
Cooling	6.89	2.73
Auxiliary	12.49	12.94
Lighting	9.4	15.63
Hot water	2.04	1.99
Equipment*	28.87	28.87
TOTAL**	**39.66**	**51.32**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	4.11
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*4.11*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	108.89	104.27
Primary energy [kWh_{PE}/m^2]	57.91	67.15
Total emissions [kg/m^2]	6.86	9.14

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	28.5	80.4	8.8	6.9	12.5	0.89	3.24	1	3.92
	Notional	58.8	45.5	18	2.7	12.9	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block I - Resi Areas - Be Lean

As built

Date: Fri Aug 04 17:53:49 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 9.7

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	12.67	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	10.55	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	137.2	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	114.26	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	GF000000:Surf[3]
Floors	0.18	0.1	0.1	GF000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	1.4	1.4	GF000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Heat Pump (no cooling) (Lean)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	-	0.2	1.1	0.85
Standard value	2.5*	N/A	N/A	1.9^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- Heat Pump (Hot water Lean)

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	2.86	-
Standard value	1	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Lobby	125	-	-
Parcel	125	-	-
Resi Amenity	125	120	1.25

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Resi Amenity	NO (-24.1%)	NO

Regulation 25A: Consideration of high efficiency 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

	Actual	Notional
Floor area [m^2]	106.7	106.7
External area [m^2]	213.3	213.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	71	82.93
Average U-value [W/m^2K]	0.33	0.39
Alpha value* [%]	10	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	3.81	4.95
Cooling	0	0
Auxiliary	11.81	19.81
Lighting	11.52	15.43
Hot water	48.13	52.48
Equipment*	62.2	62.2
TOTAL**	**75.27**	**92.68**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	38.48	49.56
Primary energy [kWh_{PE}/m^2]	114.26	137.2
Total emissions [kg/m^2]	10.55	12.67

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	38.5	0	3.8	0	11.8	2.81	0	2.64	0
Notional	49.6	0	5	0	11.8	2.78	0	----	----

Key to terms

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

Appendix A.4 - BRUKL Reports (Be Green)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block F - Office - Be Green

As designed

Date: Wed Aug 09 12:19:55 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 24.15

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	12.4	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	9.26	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	73.19	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	54.85	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	09000001:Surf[2]
Floors	0.18	0.1	0.1	09000001:Surf[3]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	0.8	0.8	09000001:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.8	0.8	09000001:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- System HN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
BF-04 Marketing Suite	-	-	-	-	-	-	-	0.3	-	-	N/A
Closing room	-	-	-	-	-	-	-	0.3	-	-	N/A
WC	-	-	-	-	-	-	-	0.3	-	-	N/A
Kitchennette	-	-	-	-	-	-	-	0.3	-	-	N/A
WC ACC.	-	-	-	-	-	-	-	0.3	-	-	N/A
WC	-	-	-	-	-	-	-	0.3	-	-	N/A
Cafe Offering	-	-	-	-	-	-	-	0.3	-	-	N/A
BF04 Marketing Suite	-	-	-	-	-	-	-	0.3	-	-	N/A
Shower	-	-	-	-	-	-	-	0.3	-	-	N/A
Shower lobby	-	-	-	-	-	-	-	0.3	-	-	N/A
Resident Offices	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
BF-04 Marketing Suite	125	-	-
Closing room	125	-	-
WC	125	-	-
Kitchennette	125	-	-
WC ACC.	125	-	-
WC	125	-	-
Cafe Offering	125	-	-
BF04 Marketing Suite	125	-	-
Shower	125	-	-
Shower lobby	125	-	-
Resident Offices	125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
BF-04 Marketing Suite	NO (-14%)	NO
Closing room	N/A	N/A
WC	N/A	N/A
Kitchennette	N/A	N/A
WC ACC.	N/A	N/A
WC	N/A	N/A
Cafe Offering	YES (+32.7%)	NO
BF04 Marketing Suite	NO (-2.7%)	NO
Shower	N/A	N/A
Shower lobby	N/A	N/A
Resident Offices	NO (-36.1%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	289.8	289.8
External area [m²]	490.3	490.3
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	147.81	187.97
Average U-value [W/m²K]	0.3	0.38
Alpha value* [%]	9.99	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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	9.63	18.16
Cooling	7.04	2.1
Auxiliary	9.78	11.58
Lighting	3.88	8.47
Hot water	19.01	24.4
Equipment*	35.73	35.73
TOTAL**	**49.33**	**64.71**

* Energy used by equipment does not count towards the total for consumption or 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	10.06	2.74
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*10.06*	*2.74*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	113.41	94.12
Primary energy [kWh_{PE}/m²]	54.85	73.19
Total emissions [kg/m²]	9.26	12.4

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	31.1	82.3	9.6	7	9.8	0.9	3.25	1	3.92
	Notional	59.2	34.9	18.2	2.1	8.9	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block F - Resi Areas - Be Green

As designed

Date: Fri Aug 04 17:17:56 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 5.81

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	7.74	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	3.91	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	60.88	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	33.15	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	0900000E:Surf[1]
Floors	0.18	0.1	0.1	0900000E:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	-	-	No windows, galzed doors, or roof windows in building
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1	1	0900000E:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- System HN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
Circulation	-	-	-	-	-	-	-	0.3	-	-	N/A
Parcel	-	-	-	-	-	-	-	0.3	-	-	N/A
Security room	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m^2]
Standard value	95	80	0.3
Circulation	125	-	-
Parcel	125	-	-
Security room	125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Circulation	N/A	N/A
Parcel	N/A	N/A
Security room	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	69.7	69.7
External area [m^2]	118.3	118.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	18.52	41.81
Average U-value [W/m^2K]	0.16	0.35
Alpha value* [%]	10	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	4.67	15.17
Cooling	3.9	3.25
Auxiliary	11.65	16.45
Lighting	12.62	12.88
Hot water	1.1	1.07
Equipment*	39.86	39.86
TOTAL**	**33.94**	**48.83**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	11.5	2.74
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*11.5*	*2.74*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	60.62	103.72
Primary energy [kWh_{PE}/m^2]	33.15	60.88
Total emissions [kg/m^2]	3.91	7.74

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity									
Actual	15.1	45.6	4.7	3.9	11.7	0.9	3.25	1	3.92
Notional	49.5	54.3	15.2	3.3	16.4	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block F - Retail - Be Green

As designed

Date: Wed Aug 09 13:38:48 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 16.1

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	7.81	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.56	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	58.21	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	42.63	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	09000000:Surf[2]
Floors	0.18	0.1	0.1	09000000:Surf[3]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	0.8	0.8	09000000:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.8	0.8	09000000:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- System HN

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
BF02 Retail	-	-	-	-	-	-	-	0.3	-	-	N/A
BF01 Retail	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m^2]
Standard value	95	80	0.3
BF02 Retail	125	100	1.2
BF01 Retail	125	100	1.2

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
BF02 Retail	YES (+6.6%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
BF01 Retail	NO (-10.2%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	193.2	193.2
External area [m^2]	354.3	354.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	117.8	145.75
Average U-value [W/m^2K]	0.33	0.41
Alpha value* [%]	9.99	10

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	9.41	16.55
Cooling	8.58	2.36
Auxiliary	13.44	12.26
Lighting	6.13	14.5
Hot water	1.93	1.87
Equipment*	20.25	20.25
TOTAL**	**39.49**	**47.55**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	10.04	2.74
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*10.04*	*2.74*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	130.74	93.29
Primary energy [kWh_{PE}/m^2]	42.63	58.21
Total emissions [kg/m^2]	5.56	7.81

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity									
Actual	30.4	100.4	9.4	8.6	13.4	0.9	3.25	1	3.92
Notional	53.9	39.4	16.5	2.4	12.3	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block H - retail - Be Green

As built

Date: Wed Aug 09 14:04:20 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m^2]: 101.2

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	9.14	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	5.97	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	67.15	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	47.77	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	BL000003:Surf[5]
Floors	0.18	0.1	0.1	BL000003:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	0.8	0.8	BL000003:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	0.8	0.8	BL000003:Surf[3]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	3.92	0	1.1	0.85
Standard value	N/A	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

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

1- District heating network

	Emission factor [$kgCO_2/kWh$]	Primary energy factor [kWh_{PE}/kWh]
This building	0.273	1.356
Standard value	0.35	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
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 balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
RETAIL BH3 - 01	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH3 - 02	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH3 - 03	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH3 - 04	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 01	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 02	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 03	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 04	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 05	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 06	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 06	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 05	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 04	-	-	-	-	-	-	-	0.3	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
RETAIL BH2 - 01	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 03	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BH2 - 02	-	-	-	-	-	-	-	0.3	-	-	N/A
RETAIL BOH	-	-	-	-	-	-	-	0.3	-	-	N/A
WC & SHOWER	-	-	-	-	-	-	-	0.3	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
RETAIL BH3 - 01	125	100	1.5
RETAIL BH3 - 02	125	100	1.5
RETAIL BH3 - 03	125	100	1.5
RETAIL BH3 - 04	125	100	1.5
RETAIL BH2 - 01	125	100	1.5
RETAIL BH2 - 02	125	100	1.5
RETAIL BH2 - 03	125	100	1.5
RETAIL BH2 - 04	125	100	1.5
RETAIL BH2 - 05	125	100	1.5
RETAIL BH2 - 06	125	100	1.5
RETAIL BH2 - 06	125	100	1.5
RETAIL BH2 - 05	125	100	1.5
RETAIL BH2 - 04	125	100	1.5
RETAIL BH2 - 05	125	100	1.5
RETAIL BH2 - 04	125	100	1.5
RETAIL BH2 - 01	125	100	1.5
RETAIL BH2 - 03	125	100	1.5
RETAIL BH2 - 02	125	100	1.5
RETAIL BOH	125	-	-
WC & SHOWER	125	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
RETAIL BH3 - 01	NO (-62%)	NO
RETAIL BH3 - 02	NO (-52.4%)	NO
RETAIL BH3 - 03	NO (-44.3%)	NO
RETAIL BH3 - 04	NO (-47.5%)	NO
RETAIL BH2 - 01	NO (-43.9%)	NO
RETAIL BH2 - 02	NO (-14.3%)	NO
RETAIL BH2 - 03	NO (-23.2%)	NO
RETAIL BH2 - 04	NO (-48.4%)	NO
RETAIL BH2 - 05	YES (+14.3%)	NO
RETAIL BH2 - 06	NO (-31.9%)	NO
RETAIL BH2 - 06	NO (-31.9%)	NO
RETAIL BH2 - 05	NO (-9.6%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
RETAIL BH2 - 04	NO (-37.3%)	NO
RETAIL BH2 - 01	NO (-43.9%)	NO
RETAIL BH2 - 03	NO (-25.7%)	NO
RETAIL BH2 - 02	NO (-14.6%)	NO
RETAIL BOH	NO (-52.1%)	NO
WC & SHOWER	N/A	N/A

Regulation 25A: Consideration of high efficiency alternative energy systems

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

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	809.6	809.6
External area [m^2]	1526.3	1526.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	431.71	620.95
Average U-value [W/m^2K]	0.28	0.41
Alpha value* [%]	9.99	10

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

Building Use

% Area	Building Type
100	**Retail/Financial and Professional Services**
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	8.84	18.04
Cooling	6.89	2.73
Auxiliary	12.49	12.94
Lighting	9.4	15.63
Hot water	2.04	1.99
Equipment*	28.87	28.87
TOTAL**	**39.66**	**51.32**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	6.87	4.11
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*6.87*	*4.11*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	108.89	104.27
Primary energy [kWh_{PE}/m^2]	47.77	67.15
Total emissions [kg/m^2]	5.97	9.14

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] District heating, [HFT] District Heating, [CFT] Electricity										
	Actual	28.5	80.4	8.8	6.9	12.5	0.89	3.24	1	3.92
	Notional	58.8	45.5	18	2.7	12.9	0.91	4.63	----	----

Key to terms

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

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Block I - Resi Areas - Be Green

As built

Date: Fri Aug 04 17:55:56 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.22

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.22

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 9.7

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	12.67	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	9.94	
Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$	137.2	
Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$	107.73	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.14	0.14	GF000000:Surf[3]
Floors	0.18	0.1	0.1	GF000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	-	-	No flat roofs in building
Windows** and roof windows	1.6	1.4	1.4	GF000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]

* 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. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m^2K

NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	2.5

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Heat Pump (no cooling)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.1	-	0.2	1.1	0.85
Standard value	2.5*	N/A	N/A	1.9^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

1- Heat Pump (Hot water)

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	3.1	-
Standard value	1	N/A

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Lobby	125	-	-
Parcel	125	-	-
Resi Amenity	125	120	1.25

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Resi Amenity	NO (-24.1%)	NO

Regulation 25A: Consideration of high efficiency 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

	Actual	Notional
Floor area [m^2]	106.7	106.7
External area [m^2]	213.3	213.3
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	71	82.93
Average U-value [W/m^2K]	0.33	0.39
Alpha value* [%]	10	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
100	**Hotels**
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	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/m^2]

	Actual	Notional
Heating	3.24	4.95
Cooling	0	0
Auxiliary	11.81	19.81
Lighting	11.52	15.43
Hot water	44.4	52.48
Equipment*	62.2	62.2
TOTAL**	**70.98**	**92.68**

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

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	38.48	49.56
Primary energy [kWh_{PE}/m^2]	107.73	137.2
Total emissions [kg/m^2]	9.94	12.67

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Central heating using air distribution, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	38.5	0	3.2	0	11.8	3.3	0	3.1	0
Notional	49.6	0	5	0	11.8	2.78	0	----	----

Key to terms

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

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