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|               |  |                 |            |
|---------------|--|-----------------|------------|
| Assessor name | Mr Adrian Fell   | Assessor number | 3536       |
| Client        |  | Last modified   | 23/05/2019 |
| Address       | B5-A-13-05 West Cromwell Road, Kensington, London, W14 8 |                 |            |

### 1. Overall dwelling dimensions

|                  | Area (m <sup>2</sup> )   |   | Average storey height (m)              |   | Volume (m <sup>3</sup> )                 |
|------------------|--|---|--|---|--|
| Lowest occupied  | <input type="text" value="53.00"/> (1a)                                    | x | <input type="text" value="2.55"/> (2a) | = | <input type="text" value="135.15"/> (3a) |
| Total floor area | (1a) + (1b) + (1c) + (1d)...(1n) = <input type="text" value="53.00"/> (4)  |   |  |   |  |
| Dwelling volume  | (3a) + (3b) + (3c) + (3d)...(3n) = <input type="text" value="135.15"/> (5) |   |  |   |  |

### 2. Ventilation rate

|                              |                                |        | m <sup>3</sup> per hour             |
|------------------------------|--------------------------------|--------|-------------------------------------|
| Number of chimneys           | <input type="text" value="0"/> | x 40 = | <input type="text" value="0"/> (6a) |
| Number of open flues         | <input type="text" value="0"/> | x 20 = | <input type="text" value="0"/> (6b) |
| Number of intermittent fans  | <input type="text" value="0"/> | x 10 = | <input type="text" value="0"/> (7a) |
| Number of passive vents      | <input type="text" value="0"/> | x 10 = | <input type="text" value="0"/> (7b) |
| Number of flueless gas fires | <input type="text" value="0"/> | x 40 = | <input type="text" value="0"/> (7c) |

#### Air changes per hour

|   |   |         |                                       |
|---|---|---------|---------------------------------------|
| Infiltration due to chimneys, flues, fans, PSVs | (6a) + (6b) + (7a) + (7b) + (7c) = <input type="text" value="0"/> | ÷ (5) = | <input type="text" value="0.00"/> (8) |
|---|---|---------|---------------------------------------|

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

|  |  |
|--|--|
| Air permeability value, q <sub>50</sub> , expressed in cubic metres per hour per square metre of envelope area | <input type="text" value="3.00"/> (17) |
|--|--|

|  |  |
|--|--|
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) | <input type="text" value="0.15"/> (18) |
|--|--|

|  |                                     |
|--|-------------------------------------|
| Number of sides on which the dwelling is sheltered | <input type="text" value="3"/> (19) |
|--|-------------------------------------|

|                |   |
|----------------|---|
| Shelter factor | 1 - [0.075 x (19)] = <input type="text" value="0.78"/> (20) |
|----------------|---|

|  |  |
|--|--|
| Infiltration rate incorporating shelter factor | (18) x (20) = <input type="text" value="0.12"/> (21) |
|--|--|

Infiltration rate modified for monthly wind speed:

|  | Jan                               | Feb                               | Mar                               | Apr                               | May                               | Jun                               | Jul                               | Aug                               | Sep                               | Oct                               | Nov                               | Dec                                    |
|--|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|
| Monthly average wind speed from Table U2 | <input type="text" value="5.10"/> | <input type="text" value="5.00"/> | <input type="text" value="4.90"/> | <input type="text" value="4.40"/> | <input type="text" value="4.30"/> | <input type="text" value="3.80"/> | <input type="text" value="3.80"/> | <input type="text" value="3.70"/> | <input type="text" value="4.00"/> | <input type="text" value="4.30"/> | <input type="text" value="4.50"/> | <input type="text" value="4.70"/> (22) |

Wind factor (22)m ÷ 4

|                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |   |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|
| <input type="text" value="1.28"/> | <input type="text" value="1.25"/> | <input type="text" value="1.23"/> | <input type="text" value="1.10"/> | <input type="text" value="1.08"/> | <input type="text" value="0.95"/> | <input type="text" value="0.95"/> | <input type="text" value="0.93"/> | <input type="text" value="1.00"/> | <input type="text" value="1.08"/> | <input type="text" value="1.13"/> | <input type="text" value="1.18"/> (22a) |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m

|                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |   |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|
| <input type="text" value="0.15"/> | <input type="text" value="0.15"/> | <input type="text" value="0.14"/> | <input type="text" value="0.13"/> | <input type="text" value="0.12"/> | <input type="text" value="0.11"/> | <input type="text" value="0.11"/> | <input type="text" value="0.11"/> | <input type="text" value="0.12"/> | <input type="text" value="0.12"/> | <input type="text" value="0.13"/> | <input type="text" value="0.14"/> (22b) |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|

Calculate effective air change rate for the applicable case:

|   |   |
|---|---|
| If mechanical ventilation: air change rate through system | <input type="text" value="0.50"/> (23a) |
|---|---|

|  |  |
|--|--|
| If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h | <input type="text" value="79.90"/> (23c) |
|--|--|

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

|                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |   |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|
| <input type="text" value="0.25"/> | <input type="text" value="0.25"/> | <input type="text" value="0.24"/> | <input type="text" value="0.23"/> | <input type="text" value="0.23"/> | <input type="text" value="0.21"/> | <input type="text" value="0.21"/> | <input type="text" value="0.21"/> | <input type="text" value="0.22"/> | <input type="text" value="0.23"/> | <input type="text" value="0.23"/> | <input type="text" value="0.24"/> (24a) |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|---|

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

|                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |                                   |  |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|
| <input type="text" value="0.25"/> | <input type="text" value="0.25"/> | <input type="text" value="0.24"/> | <input type="text" value="0.23"/> | <input type="text" value="0.23"/> | <input type="text" value="0.21"/> | <input type="text" value="0.21"/> | <input type="text" value="0.21"/> | <input type="text" value="0.22"/> | <input type="text" value="0.23"/> | <input type="text" value="0.23"/> | <input type="text" value="0.24"/> (25) |
|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|--|

### 3. Heat losses and heat loss parameter

| Element   | Gross<br>area, m <sup>2</sup> | Openings<br>m <sup>2</sup> | Net area<br>A, m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U W/K | κ-value,<br>kJ/m <sup>2</sup> .K     | A x κ,<br>kJ/K |       |       |       |       |            |      |
|---|-------------------------------|----------------------------|-------------------------------|-------------------------------|-----------|--------------------------------------|----------------|-------|-------|-------|-------|------------|------|
| Window  |                               |                            | 13.38                         | x 1.15                        | = 15.32   |                                      | (27)           |       |       |       |       |            |      |
| External wall   |                               |                            | 38.67                         | x 0.15                        | = 5.80    |                                      | (29a)          |       |       |       |       |            |      |
| Party wall  |                               |                            | 40.19                         | x 0.00                        | = 0.00    |                                      | (32)           |       |       |       |       |            |      |
| Roof  |                               |                            | 53.00                         | x 0.12                        | = 6.36    |                                      | (30)           |       |       |       |       |            |      |
| Total area of external elements ΣA, m <sup>2</sup>          |                               |                            | 105.05                        |                               |           |                                      | (31)           |       |       |       |       |            |      |
| Fabric heat loss, W/K = Σ(A × U)                            |                               |                            |                               |                               |           | (26)...(30) + (32) =                 | 27.48 (33)     |       |       |       |       |            |      |
| Heat capacity Cm = Σ(A × κ)                                 |                               |                            |                               |                               |           | (28)...(30) + (32) + (32a)...(32e) = | N/A (34)       |       |       |       |       |            |      |
| Thermal mass parameter (TMP) in kJ/m <sup>2</sup> K         |                               |                            |                               |                               |           |                                      | 250.00 (35)    |       |       |       |       |            |      |
| Thermal bridges: Σ(L × Ψ) calculated using Appendix K       |                               |                            |                               |                               |           |                                      | 15.76 (36)     |       |       |       |       |            |      |
| Total fabric heat loss                                      |                               |                            |                               |                               |           | (33) + (36) =                        | 43.24 (37)     |       |       |       |       |            |      |
|   | Jan                           | Feb                        | Mar                           | Apr                           | May       | Jun                                  | Jul            | Aug   | Sep   | Oct   | Nov   | Dec        |      |
| Ventilation heat loss calculated monthly 0.33 x (25)m x (5) | 11.09                         | 10.96                      | 10.83                         | 10.19                         | 10.06     | 9.41                                 | 9.41           | 9.28  | 9.67  | 10.06 | 10.32 | 10.57      | (38) |
| Heat transfer coefficient, W/K (37)m + (38)m                | 54.33                         | 54.20                      | 54.07                         | 53.42                         | 53.29     | 52.65                                | 52.65          | 52.52 | 52.91 | 53.29 | 53.55 | 53.81      |      |
|   | Average = Σ(39)1...12/12 =    |                            |                               |                               |           |                                      |                |       |       |       |       | 53.39 (39) |      |
| Heat loss parameter (HLP), W/m <sup>2</sup> K (39)m ÷ (4)   | 1.03                          | 1.02                       | 1.02                          | 1.01                          | 1.01      | 0.99                                 | 0.99           | 0.99  | 1.00  | 1.01  | 1.01  | 1.02       |      |
|   | Average = Σ(40)1...12/12 =    |                            |                               |                               |           |                                      |                |       |       |       |       | 1.01 (40)  |      |
| Number of days in month (Table 1a)                          | 31.00                         | 28.00                      | 31.00                         | 30.00                         | 31.00     | 30.00                                | 31.00          | 31.00 | 30.00 | 31.00 | 30.00 | 31.00      | (40) |

### 4. Water heating energy requirement

|  |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |
|--|--------|--------|--------|-------|-------|-------|-------|-------|-------|--------|--------|-----------------------|---------|------|
| Assumed occupancy, N   |        |        |        |       |       |       |       |       |       |        |        | 1.78                  | (42)    |      |
| Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$                                  |        |        |        |       |       |       |       |       |       |        |        | 76.44                 | (43)    |      |
|  | Jan    | Feb    | Mar    | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct    | Nov    | Dec                   |         |      |
| Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$                   |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |
|  | 84.08  | 81.03  | 77.97  | 74.91 | 71.85 | 68.80 | 68.80 | 71.85 | 74.91 | 77.97  | 81.03  | 84.08                 |         |      |
|  |        |        |        |       |       |       |       |       |       |        |        | $\sum(44)_{1...12} =$ | 917.29  | (44) |
| Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d) |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |
|  | 124.70 | 109.06 | 112.54 | 98.11 | 94.14 | 81.24 | 75.28 | 86.38 | 87.42 | 101.88 | 111.20 | 120.76                |         |      |
|  |        |        |        |       |       |       |       |       |       |        |        | $\sum(45)_{1...12} =$ | 1202.71 | (45) |
| Distribution loss $0.15 \times (45)m$  |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |
|  | 18.70  | 16.36  | 16.88  | 14.72 | 14.12 | 12.19 | 11.29 | 12.96 | 13.11 | 15.28  | 16.68  | 18.11                 | (46)    |      |
| Storage volume (litres) including any solar or WWHRS storage within same vessel  |        |        |        |       |       |       |       |       |       |        |        | 4.00                  | (47)    |      |
| Water storage loss:  |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |
| b) Manufacturer's declared loss factor is not known  |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |
| Hot water storage loss factor from Table 2 (kWh/litre/day)   |        |        |        |       |       |       |       |       |       |        |        | 0.02                  | (51)    |      |
| Volume factor from Table 2a  |        |        |        |       |       |       |       |       |       |        |        | 3.11                  | (52)    |      |
| Temperature factor from Table 2b   |        |        |        |       |       |       |       |       |       |        |        | 1.00                  | (53)    |      |
| Energy lost from water storage (kWh/day) $(47) \times (51) \times (52) \times (53)$                                    |        |        |        |       |       |       |       |       |       |        |        | 0.30                  | (54)    |      |
| Enter (50) or (54) in (55)   |        |        |        |       |       |       |       |       |       |        |        | 0.30                  | (55)    |      |
| Water storage loss calculated for each month $(55) \times (41)m$   |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |
|  | 9.23   | 8.34   | 9.23   | 8.94  | 9.23  | 8.94  | 9.23  | 9.23  | 8.94  | 9.23   | 8.94   | 9.23                  | (56)    |      |
| If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$ , else (56)    |        |        |        |       |       |       |       |       |       |        |        |                       |         |      |

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 9.23 | 8.34 | 9.23 | 8.94 | 9.23 | 8.94 | 9.23 | 9.23 | 8.94 | 9.23 | 8.94 | 9.23 | (57) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

Primary circuit loss for each month from Table 3

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Combi loss for each month from Table 3a, 3b or 3c

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (61) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

Total heat required for water heating calculated for each month  $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 157.19 | 138.41 | 145.04 | 129.56 | 126.64 | 112.69 | 107.78 | 118.88 | 118.86 | 134.37 | 142.65 | 153.26 | (62) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Solar DHW input calculated using Appendix G or Appendix H

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (63) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

Output from water heater for each month (kWh/month) (62)m + (63)m

|                      |        |        |        |        |        |        |        |        |        |        |         |      |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|------|
| 157.19               | 138.41 | 145.04 | 129.56 | 126.64 | 112.69 | 107.78 | 118.88 | 118.86 | 134.37 | 142.65 | 153.26  |      |
| $\Sigma(64)1...12 =$ |        |        |        |        |        |        |        |        |        |        | 1585.33 | (64) |

Heat gains from water heating (kWh/month)  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 67.46 | 59.74 | 63.42 | 57.78 | 57.30 | 52.17 | 51.03 | 54.72 | 54.22 | 59.87 | 62.13 | 66.15 | (65) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 5. Internal gains

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

Metabolic gains (Table 5)

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | 88.93 | (66) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

|       |       |      |      |      |      |      |      |      |       |       |       |      |
|-------|-------|------|------|------|------|------|------|------|-------|-------|-------|------|
| 13.82 | 12.27 | 9.98 | 7.56 | 5.65 | 4.77 | 5.15 | 6.70 | 8.99 | 11.42 | 13.32 | 14.20 | (67) |
|-------|-------|------|------|------|------|------|------|------|-------|-------|-------|------|

Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 155.02 | 156.63 | 152.57 | 143.94 | 133.05 | 122.81 | 115.97 | 114.36 | 118.42 | 127.05 | 137.94 | 148.18 | (68) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

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

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | 31.89 | (69) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Pump and fan gains (Table 5a)

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | (70) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

Losses e.g. evaporation (Table 5)

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | -71.14 | (71) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Water heating gains (Table 5)

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 90.67 | 88.90 | 85.24 | 80.25 | 77.02 | 72.46 | 68.59 | 73.55 | 75.31 | 80.47 | 86.30 | 88.91 | (72) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 309.19 | 307.48 | 297.47 | 281.43 | 265.39 | 249.72 | 239.39 | 244.29 | 252.40 | 268.61 | 287.24 | 300.97 | (73) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

## 6. Solar gains

|           | Access factor<br>Table 6d |   | Area<br>m <sup>2</sup> |   | Solar flux<br>W/m <sup>2</sup> |         | g<br>specific data<br>or Table 6b |   | FF<br>specific data<br>or Table 6c |   | Gains<br>W |      |
|-----------|---------------------------|---|------------------------|---|--------------------------------|---------|-----------------------------------|---|------------------------------------|---|------------|------|
| NorthEast | 0.77                      | x | 13.38                  | x | 11.28                          | x 0.9 x | 0.50                              | x | 0.80                               | = | 41.85      | (75) |

Solar gains in watts  $\Sigma(74)m...(82)m$

|       |       |        |        |        |        |        |        |        |        |       |       |      |
|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------|
| 41.85 | 85.18 | 153.47 | 252.04 | 338.80 | 361.19 | 337.89 | 269.37 | 187.01 | 104.10 | 52.66 | 34.17 | (83) |
|-------|-------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|------|

Total gains - internal and solar (73)m + (83)m

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 351.03 | 392.67 | 450.94 | 533.47 | 604.19 | 610.91 | 577.28 | 513.66 | 439.40 | 372.71 | 339.89 | 335.15 | (84) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(°C)

21.00 (85)

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

Utilisation factor for gains for living area n1,m (see Table 9a)

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1.00 | 0.99 | 0.98 | 0.92 | 0.75 | 0.54 | 0.40 | 0.47 | 0.76 | 0.96 | 0.99 | 1.00 | (86) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 19.99 | 20.12 | 20.38 | 20.71 | 20.93 | 20.99 | 21.00 | 21.00 | 20.94 | 20.64 | 20.26 | 19.97 | (87) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 20.06 | 20.06 | 20.07 | 20.08 | 20.08 | 20.09 | 20.09 | 20.09 | 20.08 | 20.08 | 20.07 | 20.07 | (88) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Utilisation factor for gains for rest of dwelling n2,m

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1.00 | 0.99 | 0.97 | 0.89 | 0.70 | 0.47 | 0.32 | 0.38 | 0.68 | 0.94 | 0.99 | 1.00 | (89) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 18.72 | 18.91 | 19.28 | 19.75 | 20.01 | 20.08 | 20.09 | 20.09 | 20.04 | 19.67 | 19.12 | 18.69 | (90) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Living area fraction

Living area ÷ (4) = 0.46 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 19.30 | 19.47 | 19.79 | 20.19 | 20.43 | 20.50 | 20.51 | 20.51 | 20.46 | 20.12 | 19.64 | 19.27 | (92) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Apply adjustment to the mean internal temperature from Table 4e where appropriate

|       |       |       |       |       |       |       |       |       |       |       |       |      |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| 19.30 | 19.47 | 19.79 | 20.19 | 20.43 | 20.50 | 20.51 | 20.51 | 20.46 | 20.12 | 19.64 | 19.27 | (93) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

## 8. Space heating requirement

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|

Utilisation factor for gains, ηm

|      |      |      |      |      |      |      |      |      |      |      |      |      |
|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0.99 | 0.99 | 0.97 | 0.90 | 0.72 | 0.50 | 0.36 | 0.42 | 0.72 | 0.95 | 0.99 | 1.00 | (94) |
|------|------|------|------|------|------|------|------|------|------|------|------|------|

Useful gains, ηmGm, W (94)m x (84)m

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 349.11 | 388.47 | 437.57 | 477.64 | 435.23 | 307.22 | 205.25 | 214.71 | 315.25 | 352.49 | 336.11 | 333.70 | (95) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Monthly average external temperature from Table U1

|      |      |      |      |       |       |       |       |       |       |      |      |      |
|------|------|------|------|-------|-------|-------|-------|-------|-------|------|------|------|
| 4.30 | 4.90 | 6.50 | 8.90 | 11.70 | 14.60 | 16.60 | 16.40 | 14.10 | 10.60 | 7.10 | 4.20 | (96) |
|------|------|------|------|-------|-------|-------|-------|-------|-------|------|------|------|

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

|        |        |        |        |        |        |        |        |        |        |        |        |      |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 814.98 | 789.70 | 718.37 | 603.37 | 465.37 | 310.57 | 205.63 | 215.62 | 336.28 | 507.21 | 671.75 | 811.13 | (97) |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

|        |        |        |       |       |      |      |      |      |        |        |        |  |
|--------|--------|--------|-------|-------|------|------|------|------|--------|--------|--------|--|
| 346.61 | 269.62 | 208.92 | 90.53 | 22.42 | 0.00 | 0.00 | 0.00 | 0.00 | 115.11 | 241.66 | 355.21 |  |
|--------|--------|--------|-------|-------|------|------|------|------|--------|--------|--------|--|

Σ(98)1...5, 10...12 = 1650.08 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 31.13 (99)

## 9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11) '0' if none 0.00 (301)

Fraction of space heat from community system 1 - (301) = 1.00 (302)

Fraction of community heat from boilers 0.29 (303a)

Fraction of community heat from heat pump 0.71 (303b)

Fraction of total space heat from community boilers (302) x (303a) = 0.29 (304a)

Fraction of total space heat from community heat pump (302) x (303b) = 0.71 (304b)

Factor for control and charging method (Table 4c(3)) for community space heating 1.00 (305)

Factor for charging method (Table 4c(3)) for community water heating 1.00 (305a)

Distribution loss factor (Table 12c) for community heating system 1.05 (306)

## Space heating

Annual space heating requirement 1650.08 (98)

Space heat from boilers (98) x (304a) x (305) x (306) = 502.45 (307a)

Space heat from heat pump (98) x (304b) x (305) x (306) = 1230.13 (307b)

## Water heating

Annual water heating requirement 1585.33 (64)

Water heat from boilers (64) x (303a) x (305a) x (306) = 482.73 (310a)

|  |  |         |        |
|--|--|---------|--------|
| Water heat from heat pump  | $(64) \times (303b) \times (305a) \times (306) =$                  | 1181.86 | (310b) |
| Electricity used for heat distribution   | $0.01 \times [(307a)...(307e) + (310a)...(310e)] =$                | 33.97   | (313)  |
| Electricity for pumps, fans and electric keep-hot (Table 4f)                   |  |         |        |
| mechanical ventilation fans - balanced, extract or positive input from outside |  | 127.78  | (330a) |
| Total electricity for the above, kWh/year                                      |  | 127.78  | (331)  |
| Electricity for lighting (Appendix L)  |  | 244.06  | (332)  |
| Total delivered energy for all uses  | $(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =$ | 3769.03 | (338)  |

#### 10b. Fuel costs - community heating scheme

|                              | Fuel<br>kWh/year |   | Fuel price |                                     | Fuel<br>cost £/year |        |
|------------------------------|------------------|---|------------|-------------------------------------|---------------------|--------|
| Space heating from boilers   | 502.45           | x | 4.24       | x 0.01 =                            | 21.30               | (340a) |
| Space heating from heat pump | 1230.13          | x | 4.24       | x 0.01 =                            | 52.16               | (340b) |
| Water heating from boilers   | 482.73           | x | 4.24       | x 0.01 =                            | 20.47               | (342a) |
| Water heating from heat pump | 1181.86          | x | 4.24       | x 0.01 =                            | 50.11               | (342b) |
| Pumps and fans               | 127.78           | x | 13.19      | x 0.01 =                            | 16.85               | (349)  |
| Electricity for lighting     | 244.06           | x | 13.19      | x 0.01 =                            | 32.19               | (350)  |
| Additional standing charges  |                  |   |            |                                     | 120.00              | (351)  |
| Total energy cost            |                  |   |            | $(340a)...(342e) + (345)...(354) =$ | 313.09              | (355)  |

#### 11b. SAP rating - community heating scheme

|                                 |       |       |
|---------------------------------|-------|-------|
| Energy cost deflator (Table 12) | 0.42  | (356) |
| Energy cost factor (ECF)        | 1.34  | (357) |
| SAP value                       | 81.28 |       |
| SAP rating (section 13)         | 81    | (358) |
| SAP band                        | B     |       |

#### 12b. CO<sub>2</sub> emissions - community heating scheme

|   | Energy<br>kWh/year                         |         | Emission factor |                    | Emissions<br>(kg/year) |              |
|---|--|---------|-----------------|--------------------|------------------------|--------------|
| Emissions from other sources (space heating)                  |  |         |                 |                    |                        |              |
| Efficiency of boilers   | 93.19                                      |         |                 |                    |                        | (367a)       |
| CO <sub>2</sub> emissions from boilers                        | $[(307a)+(310a)] \times 100 \div (367a) =$ | 1057.17 | x               | 0.216              | =                      | 228.35 (367) |
| Efficiency of heat pump                                       | 333.00                                     |         |                 |                    |                        | (367b)       |
| CO <sub>2</sub> emissions from heat pump                      | $[(307b)+(310b)] \times 100 \div (367b) =$ | 724.32  | x               | 0.519              | =                      | 375.92 (368) |
| Electrical energy for community heat distribution             | 33.97                                      | x       | 0.519           | =                  | 17.63                  | (372)        |
| Total CO <sub>2</sub> associated with community systems       |  |         |                 |                    | 621.90                 | (373)        |
| Total CO <sub>2</sub> associated with space and water heating |  |         |                 |                    | 621.90                 | (376)        |
| Pumps and fans  | 127.78                                     | x       | 0.519           | =                  | 66.32                  | (378)        |
| Electricity for lighting                                      | 244.06                                     | x       | 0.519           | =                  | 126.67                 | (379)        |
| Total CO <sub>2</sub> , kg/year                               |  |         |                 | $(376)..(382) =$   | 814.89                 | (383)        |
| Dwelling CO <sub>2</sub> emission rate                        |  |         |                 | $(383) \div (4) =$ | 15.38                  | (384)        |
| EI value  |  |         |                 |                    | 88.86                  |              |
| EI rating (section 14)  |  |         |                 |                    | 89                     | (385)        |
| EI band   |  |         |                 |                    | B                      |              |

#### 13b. Primary energy - community heating scheme

|  | Energy<br>kWh/year |  | Primary factor |  | Primary energy<br>(kWh/year) |  |
|--|--------------------|--|----------------|--|------------------------------|--|
|--|--------------------|--|----------------|--|------------------------------|--|

Primary energy from other sources (space heating)

|  |  |         |   |      |   |               |
|--|--|---------|---|------|---|---------------|
| Efficiency of boilers  | 93.19                                      |         |   |      |   | (367a)        |
| Primary energy from boilers                                  | $[(307a)+(310a)] \times 100 \div (367a) =$ | 1057.17 | x | 1.22 | = | 1289.75 (367) |
| Efficiency of heat pump                                      | 333.00                                     |         |   |      |   | (367b)        |
| Primary energy from heat pump                                | $[(307b)+(310b)] \times 100 \div (367b) =$ | 724.32  | x | 3.07 | = | 2223.67 (368) |
| Electrical energy for community heat distribution            | 33.97                                      |         | x | 3.07 | = | 104.29 (372)  |
| Total primary energy associated with community systems       |  |         |   |      |   | 3617.72 (373) |
| Total primary energy associated with space and water heating |  |         |   |      |   | 3617.72 (376) |
| Pumps and fans   | 127.78                                     |         | x | 3.07 | = | 392.30 (378)  |
| Electricity for lighting                                     | 244.06                                     |         | x | 3.07 | = | 749.28 (379)  |
| Primary energy kWh/year                                      |  |         |   |      |   | 4759.29 (383) |
| Dwelling primary energy rate kWh/m2/year                     |  |         |   |      |   | 89.80 (384)   |