

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



|                                    |                                                                               |               |               |      |                |            |
|------------------------------------|-------------------------------------------------------------------------------|---------------|---------------|------|----------------|------------|
| Property Reference                 | 4907-P637-6633-569                                                            |               |               |      | Issued on Date | 22/03/2023 |
| Assessment Reference               | Plot 569                                                                      | Prop Type Ref | Marlow-As-DET |      |                |            |
| Property                           | Plot 569, 2 Bed, K, WC, B                                                     |               |               |      |                |            |
|                                    |                                                                               |               |               |      |                |            |
| SAP Rating                         | 83 B                                                                          | DER           | 19.10         | TER  | 20.54          |            |
| Environmental                      | 85 B                                                                          | % DER<TER     | 7.03          |      |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.28                                                                          | DFEE          | 56.25         | TFEE | 64.67          |            |
| General Requirements Compliance    | Pass                                                                          | % DFEE<TFEE   | 13.02         |      |                |            |
|                                    |                                                                               |               |               |      |                |            |
| Assessor Details                   | Miss Maja Stanisz, Maja Stanisz, Tel: 01392 581 875, maja.stanisz@aessc.co.uk |               |               |      | Assessor ID    | Q919-0001  |
| Client                             |                                                                               |               |               |      |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### DWELLING AS DESIGNED

Detached House, total floor area 80 m<sup>2</sup>

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

#### 1a TER and DER

Fuel for main heating:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 20.54 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 19.10 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 64.7 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE) 56.3 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.25 (max. 0.30) | 0.25 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.12 (max. 0.25) | 0.12 (max. 0.70) | OK |
| Roof          | 0.16 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings      | 1.30 (max. 2.00) | 1.30 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 5.01 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from database

Ideal LOGIC COMBI ESP1 35

Combi boiler

Efficiency: 89.6% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes

OK

#### 7 Low energy lights

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

Minimum 75% OK

#### 8 Mechanical ventilation

Not applicable

#### 9 Summertime temperature

Overheating risk (Thames Valley): Medium OK

Based on:

Overshading:

Average

Windows facing North:

7.43 m<sup>2</sup>, No overhang

Windows facing West:

10.63 m<sup>2</sup>, No overhang

Air change rate:

4.00 ach

Blinds/curtains:

None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K

Floor U-value 0.12 W/m<sup>2</sup>K

Thermal bridging y-value 0.033 W/m<sup>2</sup>K

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m3 per hour           |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-----------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)  |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)  |
| Number of intermittent fans                                               |                 |                      |                             |                 | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1934 (8)            |
| Pressure test                                                             |                 |                      |                             |                 | Yes                   |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0100                |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4439 (18)           |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0 (19)                |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 1.0000 (20)           |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.4439 (21)           |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.5660 | 0.5549 | 0.5438 | 0.4883 | 0.4772 | 0.4217 | 0.4217 | 0.4106 | 0.4439 | 0.4772 | 0.4994 | 0.5216 (22b) |
|                 | 0.6602 | 0.6540 | 0.6479 | 0.6192 | 0.6139 | 0.5889 | 0.5889 | 0.5843 | 0.5985 | 0.6139 | 0.6247 | 0.6360 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Door                                                  |                         |                            | 2.1300                    | 1.3000                        | 2.7690       |                                | (26)            |
| Window (Uw = 1.30)                                          |                         |                            | 14.7300                   | 1.2357                        | 18.2025      |                                | (27)            |
| French Door (Uw = 1.30)                                     |                         |                            | 3.3300                    | 1.2357                        | 4.1150       |                                | (27)            |
| GF B&B J150 P/A=0.40                                        |                         |                            | 40.0000                   | 0.1200                        | 4.8000       | 75.0000                        | 3000.0000 (28a) |
| EW Brick AAC015                                             | 135.9700                | 20.1900                    | 115.7800                  | 0.2500                        | 28.9450      | 52.3000                        | 6055.2940 (29a) |
| Plane Ceiling                                               | 40.0000                 |                            | 40.0000                   | 0.1600                        | 6.4000       | 9.0000                         | 360.0000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 215.9700                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 65.2315      |                                | (33)            |
| GF Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| 1F Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| Internal Floor                                              |                         |                            | 40.0000                   |                               |              | 18.0000                        | 720.0000 (32d)  |
| Internal Ceiling                                            |                         |                            | 47.0000                   |                               |              | 9.0000                         | 423.0000 (32e)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss

|                                                                     |                                                                                                                                                      |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| (28)...(30) + (32) + (32a)...(32e) =                                | 11908.2940 (34)                                                                                                                                      |
|                                                                     | 148.8537 (35)                                                                                                                                        |
|                                                                     | 7.0557 (36)                                                                                                                                          |
| (33) + (36) =                                                       | 72.2872 (37)                                                                                                                                         |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                                                                                                                                                      |
| (38)m                                                               | Jan 45.0533 Feb 44.6288 Mar 44.2127 Apr 42.2585 May 41.8928 Jun 40.1907 Jul 40.1907 Aug 39.8755 Sep 40.8464 Oct 41.8928 Nov 42.6325 Dec 43.4058 (38) |
| Heat transfer coeff                                                 | 117.3405 116.9160 116.5000 114.5457 114.1800 112.4779 112.4779 112.1627 113.1336 114.1800 114.9197 115.6930 (39)                                     |
| Average = Sum(39)m / 12 =                                           | 114.5439 (39)                                                                                                                                        |
| HLP                                                                 | Jan 1.4668 Feb 1.4615 Mar 1.4562 Apr 1.4318 May 1.4273 Jun 1.4060 Jul 1.4060 Aug 1.4020 Sep 1.4142 Oct 1.4273 Nov 1.4365 Dec 1.4462 (40)             |
| HLP (average)                                                       | 1.4318 (40)                                                                                                                                          |
| Days in month                                                       | 31 28 31 30 31 30 31 31 30 31 30 31 (41)                                                                                                             |

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

|                                          |          |          |          |          |          |         |         |          |          |                    |          |                |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |          |          |                    |          | 2.4629 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 92.6930 (43)   |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 101.9622 | 98.2545  | 94.5468  | 90.8391  | 87.1314  | 83.4237 | 83.4237 | 87.1314  | 90.8391  | 94.5468            | 98.2545  | 101.9622 (44)  |
| Energy conte                             | 151.2071 | 132.2467 | 136.4667 | 118.9750 | 114.1593 | 98.5108 | 91.2848 | 104.7506 | 106.0017 | 123.5347           | 134.8478 | 146.4360 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1458.4211 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Distribution loss (46)m = 0.15 x (45)m                          | 22.6811  | 19.8370  | 20.4700  | 17.8462  | 17.1239  | 14.7766  | 13.6927  | 15.7126  | 15.9002  | 18.5302  | 20.2272  | 21.9654 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Total storage 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 (56)   |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 14.1195  | 12.7371  | 14.0662  | 13.5722  | 13.9953  | 13.5100  | 13.9393  | 13.9756  | 13.5439  | 14.0369  | 13.6308  | 14.1080 (61)  |
| Total heat required for water heating calculated for each month | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (64) |
| Heat gains from water heating, kWh/month                        | 53.8062  | 47.1563  | 48.8917  | 42.9522  | 41.4568  | 36.1324  | 33.8370  | 38.3235  | 38.6315  | 44.5845  | 48.2446  | 52.2170 (65)  |
| Solar input (sum of months) = Sum(63)m = 0.0000 (63)            |          |          |          |          |          |          |          |          |          |          |          |               |
| Total per year (kWh/year) = Sum(64)m = 1623.6559 (64)           |          |          |          |          |          |          |          |          |          |          |          |               |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 19.5599  | 17.3729  | 14.1286  | 10.6963  | 7.9956   | 6.7502   | 7.2938   | 9.4808   | 12.7251  | 16.1575  | 18.8582  | 20.1035 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 219.4405 | 221.7177 | 215.9794 | 203.7634 | 188.3429 | 173.8497 | 164.1674 | 161.8903 | 167.6286 | 179.8446 | 195.2651 | 209.7582 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 (71) |
| Water heating gains (Table 5)                                                       | 72.3202  | 70.1731  | 65.7147  | 59.6559  | 55.7215  | 50.1838  | 45.4799  | 51.5100  | 53.6549  | 59.9254  | 67.0064  | 70.1841 (72)  |
| Total internal gains                                                                | 374.2635 | 372.2066 | 358.7657 | 337.0585 | 315.0029 | 293.7267 | 279.8841 | 285.8241 | 296.9515 | 318.8704 | 344.0726 | 362.9888 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| North       |          |          |          | 7.4300     | 10.6334                        | 0.4600                            | 0.0000                             | 0.7700                       | 27.9840 (74) |          |          |               |
| West        |          |          |          | 7.3000     | 19.6403                        | 0.4600                            | 0.0000                             | 0.7700                       | 50.7830 (80) |          |          |               |
| West        |          |          |          | 3.3300     | 19.6403                        | 0.4600                            | 0.0000                             | 0.7700                       | 23.1654 (80) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 101.9324 | 198.1377 | 329.1061 | 493.4142   | 622.4404                       | 646.3909                          | 611.5146                           | 512.3873                     | 386.3338     | 235.3095 | 126.7269 | 84.1404 (83)  |
| Total gains | 476.1960 | 570.3442 | 687.8717 | 830.4726   | 937.4432                       | 940.1176                          | 891.3987                           | 798.2114                     | 683.2853     | 554.1798 | 470.7994 | 447.1292 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 28.1903 | 28.2926 | 28.3937 | 28.8781 | 28.9706 | 29.4090 | 29.4090 | 29.4916 | 29.2385                   | 28.9706 | 28.7841 | 28.5917      |
| alpha                                                                       | 2.8794  | 2.8862  | 2.8929  | 2.9252  | 2.9314  | 2.9606  | 2.9606  | 2.9661  | 2.9492                    | 2.9314  | 2.9189  | 2.9061       |
| util living area                                                            | 0.9871  | 0.9776  | 0.9546  | 0.8966  | 0.7901  | 0.6410  | 0.5073  | 0.5702  | 0.7942                    | 0.9399  | 0.9799  | 0.9892 (86)  |
| MIT                                                                         | 18.6301 | 18.8894 | 19.3528 | 19.9706 | 20.4839 | 20.8106 | 20.9310 | 20.9017 | 20.6164                   | 19.9290 | 19.1789 | 18.5991 (87) |
| Th 2                                                                        | 19.7125 | 19.7165 | 19.7205 | 19.7390 | 19.7425 | 19.7588 | 19.7588 | 19.7618 | 19.7525                   | 19.7425 | 19.7355 | 19.7281 (88) |
| util rest of house                                                          | 0.9841  | 0.9725  | 0.9438  | 0.8713  | 0.7379  | 0.5508  | 0.3824  | 0.4440  | 0.7215                    | 0.9201  | 0.9745  | 0.9867 (89)  |
| MIT 2                                                                       | 16.5902 | 16.9687 | 17.6389 | 18.5216 | 19.2093 | 19.6110 | 19.7247 | 19.7081 | 19.4067                   | 18.4858 | 17.4034 | 16.5537 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1125 (91)  |
| MIT                                                                         | 16.8197 | 17.1847 | 17.8317 | 18.6846 | 19.3527 | 19.7459 | 19.8604 | 19.8424 | 19.5428                   | 18.6482 | 17.6031 | 16.7838 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |
| adjusted MIT                                                                | 16.6697 | 17.0347 | 17.6817 | 18.5346 | 19.2027 | 19.5959 | 19.7104 | 19.6924 | 19.3928                   | 18.4982 | 17.4531 | 16.6338 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |                           |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|---------------------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec                       |
| Useful gains         | 463.0971  | 545.0310  | 632.0406  | 697.4265  | 666.6490 | 505.2917 | 336.1818 | 348.1173 | 475.2999 | 494.0556 | 451.2800  | 436.6937 (94)             |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)               |
| Heat loss rate W     | 1451.4643 | 1418.7461 | 1302.6661 | 1103.5998 | 856.6621 | 561.9325 | 349.8499 | 369.2818 | 598.7912 | 901.8157 | 1189.7781 | 1438.5094 (97)            |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)              |
| Space heating kWh    | 735.3452  | 587.1366  | 498.9453  | 292.4448  | 141.3698 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 303.3735 | 531.7186  | 745.3509 (98)             |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 3835.6846 (98)            |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | (98) / (4) = 47.9461 (99) |

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Not applicable

#### 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 %)                      |          |          |          |          |          |          |          |          |          |          |          | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 4238.3255 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 735.3452 | 587.1366 | 498.9453 | 292.4448 | 141.3698 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 303.3735 | 531.7186 | 745.3509 (98)   |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.5000  | 90.5000  | 90.5000 (210)   |
| Space heating fuel (main heating system)                              | 812.5361 | 648.7697 | 551.3208 | 323.1434 | 156.2097 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 335.2193 | 587.5344 | 823.5921 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (64)   |
| Efficiency of water heater (217)m                                     | 89.8951  | 89.8478  | 89.7376  | 89.4771  | 88.9497  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 89.4767  | 89.7816  | 87.3000 (216)   |
| Fuel for water heating, kWh/month                                     | 183.9104 | 161.3660 | 167.7479 | 148.1353 | 144.0754 | 128.3171 | 120.5316 | 135.9979 | 136.9365 | 153.7512 | 165.3775 | 178.5490 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1824.6959 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 4238.3255 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 345.4340 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6483.4554 (238) |

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

|                                             | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1               | 4238.3255          | 0.2160                        | 915.4783 (261)           |
| Space heating - secondary                   | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                  | 1824.6959          | 0.2160                        | 394.1343 (264)           |
| Space and water heating                     |                    |                               | 1309.6126 (265)          |
| Pumps and fans                              | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                         | 345.4340           | 0.5190                        | 179.2802 (268)           |
| Total CO2, kg/year                          |                    |                               | 1527.8179 (272)          |
| Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 19.1000 (273)            |

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

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 19.1000 ZC1 |
| Total Floor Area                                                                | TFA | 80.0000     |
| Assumed number of occupants                                                     | N   | 2.4629      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.2545 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.2264 ZC3  |
| Total CO2 emissions                                                             |     | 37.5808 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 37.5808 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                      |        |        |        |        |        |        |        |        |        | main                         | secondary | other  | total | m3 per hour |         |          |              |
|------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------------------------|-----------|--------|-------|-------------|---------|----------|--------------|
|                                                      |        |        |        |        |        |        |        |        |        | heating                      | heating   |        |       |             |         |          |              |
| Number of chimneys                                   |        |        |        |        |        |        |        |        |        | 0                            | +         | 0      | +     | 0           | =       | 0 * 40 = | 0.0000 (6a)  |
| Number of open flues                                 |        |        |        |        |        |        |        |        |        | 0                            | +         | 0      | +     | 0           | =       | 0 * 20 = | 0.0000 (6b)  |
| Number of intermittent fans                          |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |         | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents                              |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |         | 0 * 10 = | 0.0000 (7b)  |
| Number of flueless gas fires                         |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |         | 0 * 40 = | 0.0000 (7c)  |
|                                                      |        |        |        |        |        |        |        |        |        | Air changes per hour         |           |        |       |             |         |          |              |
| Infiltration due to chimneys, flues and fans         |        |        |        |        |        |        |        |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |           |        |       |             | 30.0000 | / (5) =  | 0.1451 (8)   |
| Pressure test                                        |        |        |        |        |        |        |        |        |        | Yes                          |           |        |       |             |         |          |              |
| Measured/design AP50                                 |        |        |        |        |        |        |        |        |        | 5.0000                       |           |        |       |             |         |          |              |
| Infiltration rate                                    |        |        |        |        |        |        |        |        |        | 0.3951 (18)                  |           |        |       |             |         |          |              |
| Number of sides sheltered                            |        |        |        |        |        |        |        |        |        | 0 (19)                       |           |        |       |             |         |          |              |
| Shelter factor                                       |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] =  |           |        |       |             | 1.0000  | (20)     |              |
| Infiltration rate adjusted to include shelter factor |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) =         |           |        |       |             | 0.3951  | (21)     |              |
|                                                      |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |         |          |              |
| Wind speed                                           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct                          | Nov       | Dec    |       |             |         |          |              |
| Wind factor                                          | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000                       | 4.5000    | 4.7000 | (22)  |             |         |          |              |
| Adj infilt rate                                      | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750                       | 1.1250    | 1.1750 | (22a) |             |         |          |              |
|                                                      | 0.5037 | 0.4938 | 0.4840 | 0.4346 | 0.4247 | 0.3753 | 0.3753 | 0.3654 | 0.3951 | 0.4247                       | 0.4445    | 0.4642 | (22b) |             |         |          |              |
| Effective ac                                         | 0.6269 | 0.6219 | 0.6171 | 0.5944 | 0.5902 | 0.5704 | 0.5704 | 0.5668 | 0.5780 | 0.5902                       | 0.5988    | 0.6077 | (25)  |             |         |          |              |

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

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|------------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| TER Opaque door                                                     |                |                | 2.1300                 | 1.0000           | 2.1300         |                   | (26)           |                |                |                |                |                     |
| TER Opening Type (Uw = 1.40)                                        |                |                | 17.8600                | 1.3258           | 23.6780        |                   | (27)           |                |                |                |                |                     |
| GF B&B J150 P/A=0.40                                                |                |                | 40.0000                | 0.1300           | 5.2000         |                   | (28a)          |                |                |                |                |                     |
| EW Brick AAC015                                                     | 135.9700       | 19.9900        | 115.9800               | 0.1800           | 20.8764        |                   | (29a)          |                |                |                |                |                     |
| Plane Ceiling                                                       | 40.0000        |                | 40.0000                | 0.1300           | 5.2000         |                   | (30)           |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 215.9700               |                  |                |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26) ... (30) + (32) = |                  | 57.0844        |                   | (33)           |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                        |                  |                |                   | 250.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                        |                  |                |                   | 10.7234 (36)   |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                        |                  |                | (33) + (36) =     | 67.8078 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                        |                  |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>42.7796 | Feb<br>42.4434 | Mar<br>42.1139         | Apr<br>40.5661   | May<br>40.2765 | Jun<br>38.9285    | Jul<br>38.9285 | Aug<br>38.6788 | Sep<br>39.4477 | Oct<br>40.2765 | Nov<br>40.8624 | Dec<br>41.4748 (38) |
| Heat transfer coeff                                                 | 110.5874       | 110.2513       | 109.9217               | 108.3739         | 108.0844       | 106.7363          | 106.7363       | 106.4866       | 107.2555       | 108.0844       | 108.6702       | 109.2826 (39)       |
| Average = Sum(39)m / 12 =                                           |                |                |                        |                  |                |                   |                |                |                |                |                | 108.3726 (39)       |
| HLP                                                                 | Jan<br>1.3823  | Feb<br>1.3781  | Mar<br>1.3740          | Apr<br>1.3547    | May<br>1.3511  | Jun<br>1.3342     | Jul<br>1.3342  | Aug<br>1.3311  | Sep<br>1.3407  | Oct<br>1.3511  | Nov<br>1.3584  | Dec<br>1.3660 (40)  |
| HLP (average)                                                       |                |                |                        |                  |                |                   |                |                |                |                |                | 1.3547 (40)         |
| Days in month                                                       | 31             | 28             | 31                     | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

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

|                                              |              |             |             |             |             |             |             |             |             |                    |             |                   |
|----------------------------------------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------|-------------|-------------------|
| Assumed occupancy                            |              |             |             |             |             |             |             |             |             |                    |             | 2.4629 (42)       |
| Average daily hot water use (litres/day)     |              |             |             |             |             |             |             |             |             |                    |             | 92.6930 (43)      |
| Daily hot water use                          | Jan 101.9622 | Feb 98.2545 | Mar 94.5468 | Apr 90.8391 | May 87.1314 | Jun 83.4237 | Jul 83.4237 | Aug 87.1314 | Sep 90.8391 | Oct 94.5468        | Nov 98.2545 | Dec 101.9622 (44) |
| Energy conte                                 | 151.2071     | 132.2467    | 136.4667    | 118.9750    | 114.1593    | 98.5108     | 91.2848     | 104.7506    | 106.0017    | 123.5347           | 134.8478    | 146.4360 (45)     |
| Energy content (annual)                      |              |             |             |             |             |             |             |             |             | Total = Sum(45)m = |             | 1458.4211 (45)    |
| Distribution loss (46)m = 0.15 x (45)m       |              |             |             |             |             |             |             |             |             |                    |             |                   |
|                                              | 22.6811      | 19.8370     | 20.4700     | 17.8462     | 17.1239     | 14.7766     | 13.6927     | 15.7126     | 15.9002     | 18.5302            | 20.2272     | 21.9654 (46)      |
| Water storage loss:                          |              |             |             |             |             |             |             |             |             |                    |             |                   |
| Total storage 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 (56)       |
| If cylinder contains dedicated solar storage |              |             |             |             |             |             |             |             |             |                    |             |                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 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 (57)   |
| Total heat required for water heating calculated for each month | 50.9589  | 45.2240  | 48.1800  | 44.7974  | 44.4012  | 41.1404  | 42.5118  | 44.4012  | 44.7974  | 48.1800  | 48.4543  | 50.9589 (61)  |
| Solar input                                                     | 202.1660 | 177.4707 | 184.6467 | 163.7723 | 158.5605 | 139.6513 | 133.7965 | 149.1518 | 150.7990 | 171.7147 | 183.3021 | 197.3949 (62) |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 202.1660 | 177.4707 | 184.6467 | 163.7723 | 158.5605 | 139.6513 | 133.7965 | 149.1518 | 150.7990 | 171.7147 | 183.3021 | 197.3949 (64) |
| Heat gains from water heating, kWh/month                        | 63.0161  | 55.2780  | 57.4202  | 50.7585  | 49.0583  | 43.0400  | 40.9801  | 45.9299  | 46.4449  | 53.1203  | 56.9505  | 61.4297 (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                                                                               | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 19.5628  | 17.3755  | 14.1307  | 10.6979  | 7.9968   | 6.7512   | 7.2949   | 9.4822   | 12.7270  | 16.1599  | 18.8609  | 20.1065  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 219.4405 | 221.7177 | 215.9794 | 203.7634 | 188.3429 | 173.8497 | 164.1674 | 161.8903 | 167.6286 | 179.8446 | 195.2651 | 209.7582 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | (71) |
| Water heating gains (Table 5)                                                       | 84.6990  | 82.2590  | 77.1777  | 70.4979  | 65.9385  | 59.7777  | 55.0808  | 61.7337  | 64.5068  | 71.3982  | 79.0979  | 82.5668  | (72) |
| Total internal gains                                                                | 386.6453 | 384.2950 | 370.2307 | 347.9021 | 325.2211 | 303.3216 | 289.4861 | 296.0492 | 307.8053 | 330.3456 | 356.1668 | 375.3744 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| North       |          |          |          |          | 7.3500     | 10.6334                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 23.8853 (74)  |
| West        |          |          |          |          | 10.5100    | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 63.0844 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 86.9697  | 169.0525 | 280.7966 | 420.9903 | 531.0835   | 551.5217                       | 521.7629                          | 437.1805                           | 329.6250 | 200.7678 | 108.1244                     | 71.7895 (83)  |
| Total gains | 473.6150 | 553.3475 | 651.0273 | 768.8924 | 856.3046   | 854.8432                       | 811.2490                          | 733.2297                           | 637.4303 | 531.1134 | 464.2913                     | 447.1640 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 50.2368 | 50.3900 | 50.5410 | 51.2628 | 51.4002 | 52.0494 | 52.0494 | 52.1714 | 51.7974 | 51.4002 | 51.1231 | 50.8366 |              |
| alpha                                                                       | 4.3491  | 4.3593  | 4.3694  | 4.4175  | 4.4267  | 4.4700  | 4.4700  | 4.4781  | 4.4532  | 4.4267  | 4.4082  | 4.3891  |              |
| util living area                                                            | 0.9980  | 0.9957  | 0.9881  | 0.9586  | 0.8746  | 0.7157  | 0.5566  | 0.6271  | 0.8719  | 0.9806  | 0.9962  | 0.9985  | (86)         |
| MIT                                                                         | 19.4523 | 19.6203 | 19.9278 | 20.3501 | 20.7098 | 20.9191 | 20.9795 | 20.9659 | 20.7909 | 20.3168 | 19.8147 | 19.4306 | (87)         |
| Th 2                                                                        | 19.7769 | 19.7801 | 19.7833 | 19.7983 | 19.8011 | 19.8141 | 19.8141 | 19.8166 | 19.8091 | 19.8011 | 19.7954 | 19.7895 | (88)         |
| util rest of house                                                          | 0.9973  | 0.9942  | 0.9835  | 0.9419  | 0.8247  | 0.6142  | 0.4176  | 0.4851  | 0.7998  | 0.9700  | 0.9945  | 0.9979  | (89)         |
| MIT 2                                                                       | 17.7327 | 17.9800 | 18.4290 | 19.0410 | 19.5201 | 19.7617 | 19.8070 | 19.8030 | 19.6388 | 19.0060 | 18.2749 | 17.7093 | (90)         |
| Living area fraction                                                        | 17.9261 | 18.1646 | 18.5976 | 19.1882 | 19.6539 | 19.8919 | 19.9389 | 19.9339 | 19.7684 | 19.1535 | 18.4481 | 17.9029 | (91)         |
| MIT                                                                         | 17.9261 | 18.1646 | 18.5976 | 19.1882 | 19.6539 | 19.8919 | 19.9389 | 19.9339 | 19.7684 | 19.1535 | 18.4481 | 17.9029 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 17.9261 | 18.1646 | 18.5976 | 19.1882 | 19.6539 | 19.8919 | 19.9389 | 19.9339 | 19.7684 | 19.1535 | 18.4481 | 17.9029 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 471.4949  | 548.3480  | 636.0407  | 715.5536  | 699.8856 | 531.2981 | 351.2730 | 366.8259 | 507.8973 | 510.6719 | 460.3676  | 445.6035  | (94)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W     | 1506.8784 | 1462.4347 | 1329.7865 | 1114.9774 | 859.6934 | 564.8364 | 356.3861 | 376.3097 | 607.9686 | 924.4990 | 1233.2038 | 1497.4918 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 770.3253  | 614.2663  | 516.1469  | 287.5851  | 118.8970 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 307.8874 | 556.4420  | 782.6049  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 3954.1549 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 49.4269   | (99)  |

#### 8c. Space cooling requirement

Not applicable

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.4000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 4233.5705 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 770.3253 | 614.2663 | 516.1469 | 287.5851 | 118.8970 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 307.8874 | 556.4420 | 782.6049  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.4000  | 93.4000  | 93.4000  | 93.4000  | 93.4000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.4000  | 93.4000  | 93.4000   | (210)           |
| Space heating fuel (main heating system)                              | 824.7595 | 657.6727 | 552.6198 | 307.9069 | 127.2987 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 329.6439 | 595.7624 | 837.9067  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 202.1660 | 177.4707 | 184.6467 | 163.7723 | 158.5605 | 139.6513 | 133.7965 | 149.1518 | 150.7990 | 171.7147 | 183.3021 | 197.3949  | (64)            |
| Efficiency of water heater (217)m                                     | 88.0965  | 87.9212  | 87.5002  | 86.4544  | 84.3378  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 86.5044  | 87.6677  | 88.1663   | (217)           |
| Fuel for water heating, kWh/month                                     | 229.4824 | 201.8520 | 211.0243 | 189.4321 | 188.0064 | 173.9119 | 166.6208 | 185.7432 | 187.7945 | 198.5040 | 209.0874 | 223.8892  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2365.3482 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 4233.5705 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 345.4850  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 7019.4037 | (238)           |

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

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 4233.5705          | 0.2160                        | 914.4512 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2365.3482          | 0.2160                        | 510.9152 (264)           |
| Space and water heating                                                                           |                    |                               | 1425.3664 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 345.4850           | 0.5190                        | 179.3067 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1643.5981 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 17.8171 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2413 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4866 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (17.8171 * 1.00) + 2.2413 + 0.4866, rounded to 2 d.p. |                    |                               | 20.5400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m3 per hour                |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 30.0000 / (5) = 0.1451 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0100                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3956 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 1.0000 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3956 (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 | 0.5043 | 0.4945 | 0.4846 | 0.4351 | 0.4252 | 0.3758 | 0.3758 | 0.3659 | 0.3956 | 0.4252 | 0.4450 | 0.4648 (22b) |
| Effective ac    | 0.6272 | 0.6222 | 0.6174 | 0.5947 | 0.5904 | 0.5706 | 0.5706 | 0.5669 | 0.5782 | 0.5904 | 0.5990 | 0.6080 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Door                                                  |                         |                            | 2.1300                    | 1.3000                        | 2.7690       |                                | (26)            |
| Window (Uw = 1.30)                                          |                         |                            | 14.7300                   | 1.2357                        | 18.2025      |                                | (27)            |
| French Door (Uw = 1.30)                                     |                         |                            | 3.3300                    | 1.2357                        | 4.1150       |                                | (27)            |
| GF B&B J150 P/A=0.40                                        |                         |                            | 40.0000                   | 0.1200                        | 4.8000       | 75.0000                        | 3000.0000 (28a) |
| EW Brick AAC015                                             | 135.9700                | 20.1900                    | 115.7800                  | 0.2500                        | 28.9450      | 52.3000                        | 6055.2940 (29a) |
| Plane Ceiling                                               | 40.0000                 |                            | 40.0000                   | 0.1600                        | 6.4000       | 9.0000                         | 360.0000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 215.9700                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 65.2315      |                                | (33)            |
| GF Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| 1F Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| Internal Floor                                              |                         |                            | 40.0000                   |                               |              | 18.0000                        | 720.0000 (32d)  |
| Internal Ceiling                                            |                         |                            | 47.0000                   |                               |              | 9.0000                         | 423.0000 (32e)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss

|                                      |                 |
|--------------------------------------|-----------------|
| (28)...(30) + (32) + (32a)...(32e) = | 11908.2940 (34) |
| 148.8537 (35)                        |                 |
| 7.0557 (36)                          |                 |
| (33) + (36) =                        | 72.2872 (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                     | 42.8015  | 42.4645  | 42.1341  | 40.5824  | 40.2921  | 38.9406  | 38.9406  | 38.6904  | 39.4612  | 40.2921  | 40.8794  | 41.4934 (38)  |
| Heat transfer coeff       | 115.0887 | 114.7517 | 114.4213 | 112.8696 | 112.5793 | 111.2278 | 111.2278 | 110.9776 | 111.7484 | 112.5793 | 113.1666 | 113.7806 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 112.8683 (39) |

  

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.4386 | 1.4344 | 1.4303 | 1.4109 | 1.4072 | 1.3903 | 1.3903 | 1.3872 | 1.3969 | 1.4072 | 1.4146 | 1.4223 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.4109 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

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

|                                          |  |  |  |  |  |  |  |  |  |  |  |              |
|------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--------------|
| Assumed occupancy                        |  |  |  |  |  |  |  |  |  |  |  | 2.4629 (42)  |
| Average daily hot water use (litres/day) |  |  |  |  |  |  |  |  |  |  |  | 92.6930 (43) |

  

|                         | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
|-------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Daily hot water use     | 101.9622 | 98.2545  | 94.5468  | 90.8391  | 87.1314  | 83.4237 | 83.4237 | 87.1314  | 90.8391  | 94.5468            | 98.2545  | 101.9622 (44)  |
| Energy conte            | 151.2071 | 132.2467 | 136.4667 | 118.9750 | 114.1593 | 98.5108 | 91.2848 | 104.7506 | 106.0017 | 123.5347           | 134.8478 | 146.4360 (45)  |
| Energy content (annual) |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1458.4211 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                              |         |         |         |         |         |         |         |         |         |         |         |              |
|----------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Distribution loss (46)m = 0.15 x (45)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 (46)  |
| Water storage loss:                          |         |         |         |         |         |         |         |         |         |         |         |              |
| Total storage 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 (56)  |
| If cylinder contains dedicated solar storage | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (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)  |
| Heat gains from water heating, kWh/month     | 32.1315 | 28.1024 | 28.9992 | 25.2822 | 24.2589 | 20.9336 | 19.3980 | 22.2595 | 22.5254 | 26.2511 | 28.6552 | 31.1176 (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                                                                               | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 19.5599  | 17.3729  | 14.1286  | 10.6963  | 7.9956   | 6.7502   | 7.2938   | 9.4808   | 12.7251  | 16.1575  | 18.8582  | 20.1035  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 219.4405 | 221.7177 | 215.9794 | 203.7634 | 188.3429 | 173.8497 | 164.1674 | 161.8903 | 167.6286 | 179.8446 | 195.2651 | 209.7582 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | (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)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | (71) |
| Water heating gains (Table 5)                                                       | 43.1875  | 41.8191  | 38.9774  | 35.1141  | 32.6060  | 29.0744  | 26.0726  | 29.9187  | 31.2852  | 35.2838  | 39.7988  | 41.8248  | (72) |
| Total internal gains                                                                | 342.1309 | 340.8526 | 329.0283 | 309.5167 | 288.8874 | 269.6172 | 257.4768 | 261.2327 | 271.5818 | 291.2287 | 313.8650 | 331.6295 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          |          |          |          |          |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| North       |          |          |          |          |          |          |          |          |          |          |          |          | 7.4300     | 10.6334                        | 0.4600                            | 0.0000                             | 0.7700                       | 27.9840 (74) |
| West        |          |          |          |          |          |          |          |          |          |          |          |          | 7.3000     | 19.6403                        | 0.4600                            | 0.0000                             | 0.7700                       | 50.7830 (80) |
| West        |          |          |          |          |          |          |          |          |          |          |          |          | 3.3300     | 19.6403                        | 0.4600                            | 0.0000                             | 0.7700                       | 23.1654 (80) |
|             |          |          |          |          |          |          |          |          |          |          |          |          |            |                                |                                   |                                    |                              |              |
| Solar gains | 101.9324 | 198.1377 | 329.1061 | 493.4142 | 622.4404 | 646.3909 | 611.5146 | 512.3873 | 386.3338 | 235.3095 | 126.7269 | 84.1404  | (83)       |                                |                                   |                                    |                              |              |
| Total gains | 444.0633 | 538.9902 | 658.1344 | 802.9309 | 911.3277 | 916.0082 | 868.9914 | 773.6201 | 657.9156 | 526.5382 | 440.5919 | 415.7699 | (84)       |                                |                                   |                                    |                              |              |

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

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 28.7418 | 28.8262 | 28.9095 | 29.3069 | 29.3825 | 29.7395 | 29.7395 | 29.8066 | 29.6010 | 29.3825 | 29.2300 | 29.0723 |              |
| alpha                                                                       | 2.9161  | 2.9217  | 2.9273  | 2.9538  | 2.9588  | 2.9826  | 2.9826  | 2.9871  | 2.9734  | 2.9588  | 2.9487  | 2.9382  |              |
| util living area                                                            | 0.9892  | 0.9805  | 0.9586  | 0.9022  | 0.7967  | 0.6483  | 0.5138  | 0.5798  | 0.8043  | 0.9460  | 0.9830  | 0.9911  | (86)         |
| MIT                                                                         | 18.6245 | 18.8845 | 19.3492 | 19.9654 | 20.4817 | 20.8086 | 20.9304 | 20.8994 | 20.6083 | 19.9137 | 19.1627 | 18.5879 | (87)         |
| Th 2                                                                        | 19.7339 | 19.7371 | 19.7402 | 19.7550 | 19.7578 | 19.7707 | 19.7707 | 19.7731 | 19.7657 | 19.7578 | 19.7522 | 19.7463 | (88)         |
| util rest of house                                                          | 0.9868  | 0.9760  | 0.9488  | 0.8782  | 0.7457  | 0.5587  | 0.3890  | 0.4537  | 0.7338  | 0.9280  | 0.9784  | 0.9891  | (89)         |
| MIT 2                                                                       | 17.5900 | 17.8501 | 18.3105 | 18.9159 | 19.3903 | 19.6681 | 19.7470 | 19.7352 | 19.5223 | 18.8820 | 18.1392 | 17.5623 | (90)         |
| Living area fraction                                                        | 17.7064 | 17.9665 | 18.4273 | 19.0340 | 19.5131 | 19.7964 | 19.8801 | 19.8662 | 19.6445 | 18.9981 | 18.2543 | 17.6777 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 17.7064 | 17.9665 | 18.4273 | 19.0340 | 19.5131 | 19.7964 | 19.8801 | 19.8662 | 19.6445 | 18.9981 | 18.2543 | 17.6777 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 435.6293  | 521.2970  | 615.4014  | 691.2197  | 668.9194 | 513.6985 | 348.4227 | 359.0989 | 477.2815 | 480.7439 | 427.5139  | 409.1838  | (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     | 1542.9279 | 1499.4003 | 1364.7409 | 1143.8218 | 879.5914 | 577.9804 | 364.8432 | 384.6662 | 619.5870 | 945.4472 | 1262.2974 | 1533.4967 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 823.8301  | 657.2855  | 557.5086  | 325.8735  | 156.7400 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 345.7393 | 601.0441  | 836.4888  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 4304.5098 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 53.8064   | (99)  |

#### 8c. Space cooling requirement

|                                                     |        |        |        |        |         |           |          |          |         |         |        |        |       |
|-----------------------------------------------------|--------|--------|--------|--------|---------|-----------|----------|----------|---------|---------|--------|--------|-------|
| Calculated for June, July and August. See Table 10b | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul      | Aug      | Sep     | Oct     | Nov    | Dec    |       |
| 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 |       |
| Heat loss rate W                                    | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1045.5417 | 823.0860 | 843.4295 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (100) |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7871    | 0.8467   | 0.8075   | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (101) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |        |        |        |        |        |           |           |          |                          |        |        |                |
|------------------------------------------|--------|--------|--------|--------|--------|-----------|-----------|----------|--------------------------|--------|--------|----------------|
| Useful loss                              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 822.9509  | 696.8941  | 681.1050 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (102)   |
| Total gains                              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1162.4462 | 1105.5878 | 995.6396 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (103)   |
| Month fracti                             | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000    | 1.0000    | 1.0000   | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (103a)  |
| Space cooling kWh                        |        |        |        |        |        |           |           |          |                          |        |        |                |
| Space cooling                            | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 244.4366  | 304.0681  | 234.0138 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (104)   |
| Cooled fraction                          |        |        |        |        |        |           |           |          |                          |        |        | 782.5185 (104) |
| Intermittency factor (Table 10b)         |        |        |        |        |        |           |           |          | FC = cooled area / (4) = |        |        | 1.0000 (105)   |
| Intermittency factor                     | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500    | 0.2500    | 0.2500   | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (106)   |
| Space cooling kWh                        |        |        |        |        |        |           |           |          |                          |        |        |                |
| Space cooling                            | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 61.1092   | 76.0170   | 58.5034  | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling per m2                     |        |        |        |        |        |           |           |          |                          |        |        | 195.6296 (107) |
| Energy for space heating                 |        |        |        |        |        |           |           |          |                          |        |        | 2.4454 (108)   |
| Energy for space cooling                 |        |        |        |        |        |           |           |          |                          |        |        | 53.8064 (99)   |
| Total                                    |        |        |        |        |        |           |           |          |                          |        |        | 2.4454 (108)   |
| Dwelling Fabric Energy Efficiency (DFEE) |        |        |        |        |        |           |           |          |                          |        |        | 56.2517 (109)  |
|                                          |        |        |        |        |        |           |           |          |                          |        |        | 56.3 (109)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           |        |        |        |        |        |        |        |        |        | main                        | secondary | other  | total | m3 per hour |   |          |              |
|---------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------------------|-----------|--------|-------|-------------|---|----------|--------------|
|                                                                           |        |        |        |        |        |        |        |        |        | heating                     | heating   |        |       |             |   |          |              |
| Number of chimneys                                                        |        |        |        |        |        |        |        |        |        | 0                           | +         | 0      | +     | 0           | = | 0 * 40 = | 0.0000 (6a)  |
| Number of open flues                                                      |        |        |        |        |        |        |        |        |        | 0                           | +         | 0      | +     | 0           | = | 0 * 20 = | 0.0000 (6b)  |
| Number of intermittent fans                                               |        |        |        |        |        |        |        |        |        |                             |           |        |       |             |   | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents                                                   |        |        |        |        |        |        |        |        |        |                             |           |        |       |             |   | 0 * 10 = | 0.0000 (7b)  |
| Number of flueless gas fires                                              |        |        |        |        |        |        |        |        |        |                             |           |        |       |             |   | 0 * 40 = | 0.0000 (7c)  |
|                                                                           |        |        |        |        |        |        |        |        |        | Air changes per hour        |           |        |       |             |   |          |              |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |        |        |        |        |        |        |        |        |        | 30.0000 / (5) =             |           |        |       |             |   |          | 0.1451 (8)   |
| Pressure test                                                             |        |        |        |        |        |        |        |        |        | Yes                         |           |        |       |             |   |          |              |
| Measured/design AP50                                                      |        |        |        |        |        |        |        |        |        |                             |           |        |       |             |   |          | 5.0000       |
| Infiltration rate                                                         |        |        |        |        |        |        |        |        |        |                             |           |        |       |             |   |          | 0.3951 (18)  |
| Number of sides sheltered                                                 |        |        |        |        |        |        |        |        |        |                             |           |        |       |             |   |          | 0 (19)       |
| Shelter factor                                                            |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] = |           |        |       |             |   |          | 1.0000 (20)  |
| Infiltration rate adjusted to include shelter factor                      |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) =        |           |        |       |             |   |          | 0.3951 (21)  |
|                                                                           |        |        |        |        |        |        |        |        |        |                             |           |        |       |             |   |          |              |
| Wind speed                                                                | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct                         | Nov       | Dec    |       |             |   |          |              |
| Wind factor                                                               | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000                      | 4.5000    | 4.7000 | (22)  |             |   |          |              |
| Adj infilt rate                                                           | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750                      | 1.1250    | 1.1750 | (22a) |             |   |          |              |
|                                                                           | 0.5037 | 0.4938 | 0.4840 | 0.4346 | 0.4247 | 0.3753 | 0.3753 | 0.3654 | 0.3951 | 0.4247                      | 0.4445    | 0.4642 | (22b) |             |   |          |              |
| Effective ac                                                              | 0.6269 | 0.6219 | 0.6171 | 0.5944 | 0.5902 | 0.5704 | 0.5704 | 0.5668 | 0.5780 | 0.5902                      | 0.5988    | 0.6077 | (25)  |             |   |          |              |

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

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|------------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| TER Opaque door                                                     |                |                | 2.1300                 | 1.0000           | 2.1300         |                   | (26)           |                |                |                |                |                     |
| TER Opening Type (Uw = 1.40)                                        |                |                | 17.8600                | 1.3258           | 23.6780        |                   | (27)           |                |                |                |                |                     |
| GF B&B J150 P/A=0.40                                                |                |                | 40.0000                | 0.1300           | 5.2000         |                   | (28a)          |                |                |                |                |                     |
| EW Brick AAC015                                                     | 135.9700       | 19.9900        | 115.9800               | 0.1800           | 20.8764        |                   | (29a)          |                |                |                |                |                     |
| Plane Ceiling                                                       | 40.0000        |                | 40.0000                | 0.1300           | 5.2000         |                   | (30)           |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 215.9700               |                  |                |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26) ... (30) + (32) = |                  | 57.0844        |                   | (33)           |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                        |                  |                |                   | 250.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                        |                  |                |                   | 10.7234 (36)   |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                        |                  |                | (33) + (36) =     | 67.8078 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                        |                  |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>42.7796 | Feb<br>42.4434 | Mar<br>42.1139         | Apr<br>40.5661   | May<br>40.2765 | Jun<br>38.9285    | Jul<br>38.9285 | Aug<br>38.6788 | Sep<br>39.4477 | Oct<br>40.2765 | Nov<br>40.8624 | Dec<br>41.4748 (38) |
| Heat transfer coeff                                                 | 110.5874       | 110.2513       | 109.9217               | 108.3739         | 108.0844       | 106.7363          | 106.7363       | 106.4866       | 107.2555       | 108.0844       | 108.6702       | 109.2826 (39)       |
| Average = Sum(39)m / 12 =                                           |                |                |                        |                  |                |                   |                |                |                |                |                | 108.3726 (39)       |
| HLP                                                                 | Jan<br>1.3823  | Feb<br>1.3781  | Mar<br>1.3740          | Apr<br>1.3547    | May<br>1.3511  | Jun<br>1.3342     | Jul<br>1.3342  | Aug<br>1.3311  | Sep<br>1.3407  | Oct<br>1.3511  | Nov<br>1.3584  | Dec<br>1.3660 (40)  |
| HLP (average)                                                       |                |                |                        |                  |                |                   |                |                |                |                |                | 1.3547 (40)         |
| Days in month                                                       | 31             | 28             | 31                     | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

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

|                                              |              |             |             |             |             |             |             |             |             |                    |             |                   |
|----------------------------------------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------|-------------|-------------------|
| Assumed occupancy                            |              |             |             |             |             |             |             |             |             |                    |             | 2.4629 (42)       |
| Average daily hot water use (litres/day)     |              |             |             |             |             |             |             |             |             |                    |             | 92.6930 (43)      |
| Daily hot water use                          | Jan 101.9622 | Feb 98.2545 | Mar 94.5468 | Apr 90.8391 | May 87.1314 | Jun 83.4237 | Jul 83.4237 | Aug 87.1314 | Sep 90.8391 | Oct 94.5468        | Nov 98.2545 | Dec 101.9622 (44) |
| Energy conte                                 | 151.2071     | 132.2467    | 136.4667    | 118.9750    | 114.1593    | 98.5108     | 91.2848     | 104.7506    | 106.0017    | 123.5347           | 134.8478    | 146.4360 (45)     |
| Energy content (annual)                      |              |             |             |             |             |             |             |             |             | Total = Sum(45)m = |             | 1458.4211 (45)    |
| Distribution loss (46)m = 0.15 x (45)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      | 0.0000 (46)       |
| Water storage loss:                          |              |             |             |             |             |             |             |             |             |                    |             |                   |
| Total storage 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 (56)       |
| If cylinder contains dedicated solar storage |              |             |             |             |             |             |             |             |             |                    |             |                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| 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 (57)  |
| Heat gains from water heating, kWh/month | 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)  |
|                                          | 32.1315 | 28.1024 | 28.9992 | 25.2822 | 24.2589 | 20.9336 | 19.3980 | 22.2595 | 22.5254 | 26.2511 | 28.6552 | 31.1176 (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                                                                               | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | 123.1431 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 19.5628  | 17.3755  | 14.1307  | 10.6979  | 7.9968   | 6.7512   | 7.2949   | 9.4822   | 12.7270  | 16.1599  | 18.8609  | 20.1065  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 219.4405 | 221.7177 | 215.9794 | 203.7634 | 188.3429 | 173.8497 | 164.1674 | 161.8903 | 167.6286 | 179.8446 | 195.2651 | 209.7582 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | 35.3143  | (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)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | (71) |
| Water heating gains (Table 5)                                                       | 43.1875  | 41.8191  | 38.9774  | 35.1141  | 32.6060  | 29.0744  | 26.0726  | 29.9187  | 31.2852  | 35.2838  | 39.7988  | 41.8248  | (72) |
| Total internal gains                                                                | 342.1338 | 340.8551 | 329.0304 | 309.5183 | 288.8885 | 269.6182 | 257.4779 | 261.2341 | 271.5837 | 291.2311 | 313.8678 | 331.6325 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |            |                                |          |                                   |          |                                    |          |                              |              |      |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|--------------|------|
|             |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d | Gains<br>W   |      |
| North       |          |          |          | 7.3500     | 10.6334                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       | 23.8853 (74) |      |
| West        |          |          |          | 10.5100    | 19.6403                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       | 63.0844 (80) |      |
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |              |      |
| Solar gains | 86.9697  | 169.0525 | 280.7966 | 420.9903   | 531.0835                       | 551.5217 | 521.7629                          | 437.1805 | 329.6250                           | 200.7678 | 108.1244                     | 71.7895      | (83) |
| Total gains | 429.1035 | 509.9076 | 609.8271 | 730.5086   | 819.9721                       | 821.1399 | 779.2408                          | 698.4147 | 601.2087                           | 491.9989 | 421.9922                     | 403.4220     | (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 50.2368 | 50.3900 | 50.5410 | 51.2628 | 51.4002 | 52.0494 | 52.0494 | 52.1714 | 51.7974                   | 51.4002 | 51.1231 | 50.8366 |              |
| alpha                                                                       | 4.3491  | 4.3593  | 4.3694  | 4.4175  | 4.4267  | 4.4700  | 4.4700  | 4.4781  | 4.4532                    | 4.4267  | 4.4082  | 4.3891  |              |
| util living area                                                            | 0.9987  | 0.9969  | 0.9907  | 0.9651  | 0.8882  | 0.7351  | 0.5761  | 0.6514  | 0.8903                    | 0.9853  | 0.9974  | 0.9990  | (86)         |
| MIT                                                                         | 19.4026 | 19.5723 | 19.8837 | 20.3138 | 20.6864 | 20.9097 | 20.9765 | 20.9604 | 20.7676                   | 20.2760 | 19.7676 | 19.3815 | (87)         |
| Th 2                                                                        | 19.7769 | 19.7801 | 19.7833 | 19.7983 | 19.8011 | 19.8141 | 19.8141 | 19.8166 | 19.8091                   | 19.8011 | 19.7954 | 19.7895 | (88)         |
| util rest of house                                                          | 0.9982  | 0.9958  | 0.9870  | 0.9507  | 0.8415  | 0.6342  | 0.4339  | 0.5071  | 0.8240                    | 0.9771  | 0.9962  | 0.9986  | (89)         |
| MIT 2                                                                       | 18.3316 | 18.5033 | 18.8153 | 19.2475 | 19.5908 | 19.7735 | 19.8085 | 19.8056 | 19.6764                   | 19.2192 | 18.7105 | 18.3202 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1125  | (91)         |
| MIT                                                                         | 18.4521 | 18.6236 | 18.9355 | 19.3675 | 19.7141 | 19.9013 | 19.9399 | 19.9355 | 19.7992                   | 19.3381 | 18.8294 | 18.4396 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.4521 | 18.6236 | 18.9355 | 19.3675 | 19.7141 | 19.9013 | 19.9399 | 19.9355 | 19.7992                   | 19.3381 | 18.8294 | 18.4396 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec       |       |
| Useful gains         | 0.9974    | 0.9942    | 0.9835    | 0.9439    | 0.8374   | 0.6425   | 0.4498   | 0.5229   | 0.8233   | 0.9725       | 0.9949    | 0.9980    | (94)  |
| Ext temp.            | 427.9820  | 506.9489  | 599.7647  | 689.5130  | 686.6197 | 527.5487 | 350.5399 | 365.1956 | 494.9943 | 478.4642     | 419.8271  | 402.6231  | (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000    | (96)  |
| Month fracti         | 1565.0442 | 1513.0425 | 1366.9328 | 1134.4019 | 866.1975 | 565.8431 | 356.4885 | 376.4827 | 611.2710 | 944.4535     | 1274.6396 | 1556.1426 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000    | (97a) |
| Space heating        | 845.9742  | 676.0949  | 570.7731  | 320.3200  | 133.6059 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 346.6961     | 615.4650  | 858.2185  | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 54.5893   | (99)  |

#### 8c. Space cooling requirement

|                                                     |        |        |        |        |         |           |           |          |         |         |        |                          |        |
|-----------------------------------------------------|--------|--------|--------|--------|---------|-----------|-----------|----------|---------|---------|--------|--------------------------|--------|
| Calculated for June, July and August. See Table 10b | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul       | Aug      | Sep     | Oct     | Nov    | Dec                      |        |
| 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                   |        |
| Heat loss rate W                                    | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1003.3211 | 789.8485  | 809.2985 | 0.0000  | 0.0000  | 0.0000 | 0.0000                   | (100)  |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.8358    | 0.8992    | 0.8611   | 0.0000  | 0.0000  | 0.0000 | 0.0000                   | (101)  |
| Useful loss                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 838.6112  | 710.2284  | 696.8472 | 0.0000  | 0.0000  | 0.0000 | 0.0000                   | (102)  |
| Total gains                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1051.5626 | 1000.6859 | 907.7391 | 0.0000  | 0.0000  | 0.0000 | 0.0000                   | (103)  |
| Month fracti                                        | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1.0000    | 1.0000    | 1.0000   | 0.0000  | 0.0000  | 0.0000 | 0.0000                   | (103a) |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 153.3250  | 216.1004  | 156.9035 | 0.0000  | 0.0000  | 0.0000 | 0.0000                   | (104)  |
| Space cooling                                       |        |        |        |        |         |           |           |          |         |         |        | 526.3289                 | (104)  |
| Cooled fraction                                     |        |        |        |        |         |           |           |          |         |         |        | 1.0000                   | (105)  |
|                                                     |        |        |        |        |         |           |           |          |         |         |        | fC = cooled area / (4) = |        |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                        |        |        |        |        |         |         |         |        |        |        |                |
|----------------------------------------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|----------------|
| Intermittency factor (Table 10b)       | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500  | 0.2500  | 0.2500  | 0.0000 | 0.0000 | 0.0000 | 0.0000 (106)   |
| Space cooling kWh                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 38.3313 | 54.0251 | 39.2259 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling                          |        |        |        |        |         |         |         |        |        |        | 131.5822 (107) |
| Space cooling per m2                   |        |        |        |        |         |         |         |        |        |        | 1.6448 (108)   |
| Energy for space heating               |        |        |        |        |         |         |         |        |        |        | 54.5893 (99)   |
| Energy for space cooling               |        |        |        |        |         |         |         |        |        |        | 1.6448 (108)   |
| Total                                  |        |        |        |        |         |         |         |        |        |        | 56.2341 (109)  |
| Target Fabric Energy Efficiency (TFEE) |        |        |        |        |         |         |         |        |        |        | 64.7 (109)     |

-----

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m3 per hour           |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-----------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)  |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)  |
| Number of intermittent fans                                               |                 |                      |                             |                 | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1934 (8)            |
| Pressure test                                                             |                 |                      |                             |                 | Yes                   |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0100                |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4439 (18)           |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0 (19)                |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 1.0000 (20)           |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.4439 (21)           |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.2000 | 4.0000 | 4.0000 | 3.7000 | 3.7000 | 3.3000 | 3.4000 | 3.2000 | 3.3000 | 3.5000 | 3.5000 | 3.8000 (22)  |
| Wind factor     | 1.0500 | 1.0000 | 1.0000 | 0.9250 | 0.9250 | 0.8250 | 0.8500 | 0.8000 | 0.8250 | 0.8750 | 0.8750 | 0.9500 (22a) |
| Adj infilt rate | 0.4661 | 0.4439 | 0.4439 | 0.4106 | 0.4106 | 0.3662 | 0.3773 | 0.3551 | 0.3662 | 0.3884 | 0.3884 | 0.4217 (22b) |
| Effective ac    | 0.6086 | 0.5985 | 0.5985 | 0.5843 | 0.5843 | 0.5671 | 0.5712 | 0.5631 | 0.5671 | 0.5754 | 0.5754 | 0.5889 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Door                                                  |                         |                            | 2.1300                    | 1.3000                        | 2.7690       |                                | (26)            |
| Window (Uw = 1.30)                                          |                         |                            | 14.7300                   | 1.2357                        | 18.2025      |                                | (27)            |
| French Door (Uw = 1.30)                                     |                         |                            | 3.3300                    | 1.2357                        | 4.1150       |                                | (27)            |
| GF B&B J150 P/A=0.40                                        |                         |                            | 40.0000                   | 0.1200                        | 4.8000       | 75.0000                        | 3000.0000 (28a) |
| EW Brick AAC015                                             | 135.9700                | 20.1900                    | 115.7800                  | 0.2500                        | 28.9450      | 52.3000                        | 6055.2940 (29a) |
| Plane Ceiling                                               | 40.0000                 |                            | 40.0000                   | 0.1600                        | 6.4000       | 9.0000                         | 360.0000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 215.9700                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            | (26)...(30) + (32) =      |                               | 65.2315      |                                | (33)            |
| GF Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| 1F Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| Internal Floor                                              |                         |                            | 40.0000                   |                               |              | 18.0000                        | 720.0000 (32d)  |
| Internal Ceiling                                            |                         |                            | 47.0000                   |                               |              | 9.0000                         | 423.0000 (32e)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss  
(28)...(30) + (32) + (32a)...(32e) = 11908.2940 (34)  
148.8537 (35)  
7.0557 (36)  
(33) + (36) = 72.2872 (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                     | 41.5356  | 40.8464  | 40.8464  | 39.8755  | 39.8755  | 38.6988  | 38.9803  | 38.4256  | 38.6988  | 39.2703  | 39.2703  | 40.1907 (38)  |
| Heat transfer coeff       | 113.8228 | 113.1336 | 113.1336 | 112.1627 | 112.1627 | 110.9860 | 111.2676 | 110.7128 | 110.9860 | 111.5575 | 111.5575 | 112.4779 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 111.9967 (39) |
| HLP                       | 1.4228   | 1.4142   | 1.4142   | 1.4020   | 1.4020   | 1.3873   | 1.3908   | 1.3839   | 1.3873   | 1.3945   | 1.3945   | 1.4060 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.4000 (40)   |
| Days in month             | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31 (41)       |

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

|                                          |          |          |          |          |          |         |         |          |          |                    |          |                |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |          |          |                    |          | 2.4629 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 92.6930 (43)   |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 101.9622 | 98.2545  | 94.5468  | 90.8391  | 87.1314  | 83.4237 | 83.4237 | 87.1314  | 90.8391  | 94.5468            | 98.2545  | 101.9622 (44)  |
| Energy conte                             | 151.2071 | 132.2467 | 136.4667 | 118.9750 | 114.1593 | 98.5108 | 91.2848 | 104.7506 | 106.0017 | 123.5347           | 134.8478 | 146.4360 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1458.4211 (45) |



|                                                                 |                      |          |          |          |          |          |          |                                          |          |          |          |                |
|-----------------------------------------------------------------|----------------------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|----------------|
| Distribution loss                                               | (46)m = 0.15 x (45)m |          |          |          |          |          |          |                                          |          |          |          |                |
|                                                                 | 22.6811              | 19.8370  | 20.4700  | 17.8462  | 17.1239  | 14.7766  | 13.6927  | 15.7126                                  | 15.9002  | 18.5302  | 20.2272  | 21.9654 (46)   |
| Water storage loss                                              |                      |          |          |          |          |          |          |                                          |          |          |          |                |
| Total storage 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 (56)    |
| If cylinder contains dedicated solar storage                    |                      |          |          |          |          |          |          |                                          |          |          |          |                |
|                                                                 | 0.0000               | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)    |
| Combi loss                                                      | 14.1195              | 12.7371  | 14.0662  | 13.5722  | 13.9953  | 13.5100  | 13.9393  | 13.9756                                  | 13.5439  | 14.0369  | 13.6308  | 14.1080 (61)   |
| Total heat required for water heating calculated for each month |                      |          |          |          |          |          |          |                                          |          |          |          |                |
|                                                                 | 165.3265             | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262                                 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (62)  |
| Solar input                                                     | 0.0000               | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
|                                                                 |                      |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 |                      |          |          |          |          |          |          |                                          |          |          |          |                |
|                                                                 | 165.3265             | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262                                 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (64)  |
|                                                                 |                      |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          | 1623.6559 (64) |
| RHI water heating demand                                        |                      |          |          |          |          |          |          |                                          |          |          |          | 1624 (64)      |
| Heat gains from water heating, kWh/month                        |                      |          |          |          |          |          |          |                                          |          |          |          |                |
|                                                                 | 53.8062              | 47.1563  | 48.8917  | 42.9522  | 41.4568  | 36.1324  | 33.8370  | 38.3235                                  | 38.6315  | 44.5845  | 48.2446  | 52.2170 (65)   |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 48.8998  | 43.4323  | 35.3215  | 26.7407  | 19.9890  | 16.8755  | 18.2346  | 23.7020  | 31.8128  | 40.3937  | 47.1454  | 50.2588 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 327.5232 | 330.9219 | 322.3573 | 304.1245 | 281.1088 | 259.4772 | 245.0260 | 241.6274 | 250.1919 | 268.4248 | 291.4405 | 313.0720 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 (71) |
| Water heating gains (Table 5)                                                       | 72.3202  | 70.1731  | 65.7147  | 59.6559  | 55.7215  | 50.1838  | 45.4799  | 51.5100  | 53.6549  | 59.9254  | 67.0064  | 70.1841 (72)  |
| Total internal gains                                                                | 553.2404 | 549.0245 | 527.8908 | 495.0183 | 461.3165 | 431.0338 | 413.2377 | 421.3367 | 440.1569 | 473.2411 | 510.0895 | 538.0122 (73) |

| [Jan] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| North | 7.4300     | 11.9814                        | 0.4600                            | 0.0000                             | 0.7700                       | 31.5316 (74) |
| West  | 7.3000     | 22.3313                        | 0.4600                            | 0.0000                             | 0.7700                       | 57.7412 (80) |
| West  | 3.3300     | 22.3313                        | 0.4600                            | 0.0000                             | 0.7700                       | 26.3395 (80) |

Regs Region: England  
Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.14r19

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m3 per hour           |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-----------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)  |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)  |
| Number of intermittent fans                                               |                 |                      |                             |                 | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1934 (8)            |
| Pressure test                                                             |                 |                      |                             |                 | Yes                   |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0100                |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4439 (18)           |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0 (19)                |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 1.0000 (20)           |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.4439 (21)           |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.5660 | 0.5549 | 0.5438 | 0.4883 | 0.4772 | 0.4217 | 0.4217 | 0.4106 | 0.4439 | 0.4772 | 0.4994 | 0.5216 (22b) |
|                 | 0.6602 | 0.6540 | 0.6479 | 0.6192 | 0.6139 | 0.5889 | 0.5889 | 0.5843 | 0.5985 | 0.6139 | 0.6247 | 0.6360 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Door                                                  |                         |                            | 2.1300                    | 1.3000                        | 2.7690       |                                | (26)            |
| Window (Uw = 1.30)                                          |                         |                            | 14.7300                   | 1.2357                        | 18.2025      |                                | (27)            |
| French Door (Uw = 1.30)                                     |                         |                            | 3.3300                    | 1.2357                        | 4.1150       |                                | (27)            |
| GF B&B J150 P/A=0.40                                        |                         |                            | 40.0000                   | 0.1200                        | 4.8000       | 75.0000                        | 3000.0000 (28a) |
| EW Brick AAC015                                             | 135.9700                | 20.1900                    | 115.7800                  | 0.2500                        | 28.9450      | 52.3000                        | 6055.2940 (29a) |
| Plane Ceiling                                               | 40.0000                 |                            | 40.0000                   | 0.1600                        | 6.4000       | 9.0000                         | 360.0000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 215.9700                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 65.2315      |                                | (33)            |
| GF Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| 1F Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| Internal Floor                                              |                         |                            | 40.0000                   |                               |              | 18.0000                        | 720.0000 (32d)  |
| Internal Ceiling                                            |                         |                            | 47.0000                   |                               |              | 9.0000                         | 423.0000 (32e)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss

|                                                                     |                                                                                                                                                      |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| (28)...(30) + (32) + (32a)...(32e) =                                | 11908.2940 (34)                                                                                                                                      |
|                                                                     | 148.8537 (35)                                                                                                                                        |
|                                                                     | 7.0557 (36)                                                                                                                                          |
| (33) + (36) =                                                       | 72.2872 (37)                                                                                                                                         |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                                                                                                                                                      |
| (38)m                                                               | Jan 45.0533 Feb 44.6288 Mar 44.2127 Apr 42.2585 May 41.8928 Jun 40.1907 Jul 40.1907 Aug 39.8755 Sep 40.8464 Oct 41.8928 Nov 42.6325 Dec 43.4058 (38) |
| Heat transfer coeff                                                 | 117.3405 116.9160 116.5000 114.5457 114.1800 112.4779 112.4779 112.1627 113.1336 114.1800 114.9197 115.6930 (39)                                     |
| Average = Sum(39)m / 12 =                                           | 114.5439 (39)                                                                                                                                        |
| HLP                                                                 | Jan 1.4668 Feb 1.4615 Mar 1.4562 Apr 1.4318 May 1.4273 Jun 1.4060 Jul 1.4060 Aug 1.4020 Sep 1.4142 Oct 1.4273 Nov 1.4365 Dec 1.4462 (40)             |
| HLP (average)                                                       | 1.4318 (40)                                                                                                                                          |
| Days in month                                                       | 31 28 31 30 31 30 31 31 30 31 30 31 (41)                                                                                                             |

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

|                                          |          |          |          |          |          |         |         |          |          |                    |          |                |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |          |          |                    |          | 2.4629 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 92.6930 (43)   |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 101.9622 | 98.2545  | 94.5468  | 90.8391  | 87.1314  | 83.4237 | 83.4237 | 87.1314  | 90.8391  | 94.5468            | 98.2545  | 101.9622 (44)  |
| Energy conte                             | 151.2071 | 132.2467 | 136.4667 | 118.9750 | 114.1593 | 98.5108 | 91.2848 | 104.7506 | 106.0017 | 123.5347           | 134.8478 | 146.4360 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1458.4211 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Distribution loss (46)m = 0.15 x (45)m                          | 22.6811  | 19.8370  | 20.4700  | 17.8462  | 17.1239  | 14.7766  | 13.6927  | 15.7126  | 15.9002  | 18.5302  | 20.2272  | 21.9654 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Total storage 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 (56)   |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 14.1195  | 12.7371  | 14.0662  | 13.5722  | 13.9953  | 13.5100  | 13.9393  | 13.9756  | 13.5439  | 14.0369  | 13.6308  | 14.1080 (61)  |
| Total heat required for water heating calculated for each month | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (64) |
| Heat gains from water heating, kWh/month                        | 53.8062  | 47.1563  | 48.8917  | 42.9522  | 41.4568  | 36.1324  | 33.8370  | 38.3235  | 38.6315  | 44.5845  | 48.2446  | 52.2170 (65)  |
| Solar input (sum of months) = Sum(63)m = 0.0000 (63)            |          |          |          |          |          |          |          |          |          |          |          |               |
| Total per year (kWh/year) = Sum(64)m = 1623.6559 (64)           |          |          |          |          |          |          |          |          |          |          |          |               |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 48.8998  | 43.4323  | 35.3215  | 26.7407  | 19.9890  | 16.8755  | 18.2346  | 23.7020  | 31.8128  | 40.3937  | 47.1454  | 50.2588 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 327.5232 | 330.9219 | 322.3573 | 304.1245 | 281.1088 | 259.4772 | 245.0260 | 241.6274 | 250.1919 | 268.4248 | 291.4405 | 313.0720 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 (71) |
| Water heating gains (Table 5)                                                       | 72.3202  | 70.1731  | 65.7147  | 59.6559  | 55.7215  | 50.1838  | 45.4799  | 51.5100  | 53.6549  | 59.9254  | 67.0064  | 70.1841 (72)  |
| Total internal gains                                                                | 553.2404 | 549.0245 | 527.8908 | 495.0183 | 461.3165 | 431.0338 | 413.2377 | 421.3367 | 440.1569 | 473.2411 | 510.0895 | 538.0122 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| North       |          |          |          |          | 7.4300     | 10.6334                        | 0.4600                            | 0.0000                             | 0.7700                       |          | 27.9840 (74) |               |
| West        |          |          |          |          | 7.3000     | 19.6403                        | 0.4600                            | 0.0000                             | 0.7700                       |          | 50.7830 (80) |               |
| West        |          |          |          |          | 3.3300     | 19.6403                        | 0.4600                            | 0.0000                             | 0.7700                       |          | 23.1654 (80) |               |
| Solar gains | 101.9324 | 198.1377 | 329.1061 | 493.4142 | 622.4404   | 646.3909                       | 611.5146                          | 512.3873                           | 386.3338                     | 235.3095 | 126.7269     | 84.1404 (83)  |
| Total gains | 655.1728 | 747.1622 | 856.9969 | 988.4324 | 1083.7568  | 1077.4247                      | 1024.7524                         | 933.7240                           | 826.4906                     | 708.5506 | 636.8163     | 622.1526 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 28.1903 | 28.2926 | 28.3937 | 28.8781 | 28.9706 | 29.4090 | 29.4090 | 29.4916 | 29.2385                   | 28.9706 | 28.7841 | 28.5917      |
| alpha                                                                       | 2.8794  | 2.8862  | 2.8929  | 2.9252  | 2.9314  | 2.9606  | 2.9606  | 2.9661  | 2.9492                    | 2.9314  | 2.9189  | 2.9061       |
| util living area                                                            | 0.9712  | 0.9569  | 0.9255  | 0.8548  | 0.7380  | 0.5839  | 0.4523  | 0.5055  | 0.7251                    | 0.8978  | 0.9578  | 0.9749 (86)  |
| MIT                                                                         | 18.8946 | 19.1402 | 19.5706 | 20.1316 | 20.5789 | 20.8534 | 20.9492 | 20.9290 | 20.7077                   | 20.1142 | 19.4171 | 18.8617 (87) |
| Th 2                                                                        | 19.7125 | 19.7165 | 19.7205 | 19.7390 | 19.7425 | 19.7588 | 19.7588 | 19.7618 | 19.7525                   | 19.7425 | 19.7355 | 19.7281 (88) |
| util rest of house                                                          | 0.9650  | 0.9478  | 0.9094  | 0.8231  | 0.6810  | 0.4950  | 0.3367  | 0.3870  | 0.6447                    | 0.8681  | 0.9473  | 0.9695 (89)  |
| MIT 2                                                                       | 16.9715 | 17.3269 | 17.9429 | 18.7329 | 19.3184 | 19.6478 | 19.7345 | 19.7246 | 19.5008                   | 18.7334 | 17.7426 | 16.9332 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1125 (91)  |
| MIT                                                                         | 17.1879 | 17.5309 | 18.1260 | 18.8902 | 19.4602 | 19.7834 | 19.8712 | 19.8601 | 19.6366                   | 18.8887 | 17.9310 | 17.1501 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |
| adjusted MIT                                                                | 17.0379 | 17.3809 | 17.9760 | 18.7402 | 19.3102 | 19.6334 | 19.7212 | 19.7101 | 19.4866                   | 18.7387 | 17.7810 | 17.0001 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |                           |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|---------------------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec                       |
| Useful gains         | 619.4817  | 690.1120  | 753.7272  | 782.7607  | 713.6457 | 522.7785 | 341.2437 | 356.3795 | 516.2833 | 592.6311 | 587.9535  | 592.1159 (94)             |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)               |
| Heat loss rate W     | 1494.6686 | 1459.2140 | 1336.9512 | 1127.1579 | 868.9314 | 566.1502 | 351.0645 | 371.2694 | 609.4003 | 929.2814 | 1227.4534 | 1480.8844 (97)            |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)              |
| Space heating kWh    | 651.1391  | 516.8365  | 433.9187  | 247.9660  | 115.5326 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 250.4678 | 460.4400  | 661.2438 (98)             |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 3337.5445 (98)            |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | (98) / (4) = 41.7193 (99) |

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

#### 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 %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3687.8945 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 651.1391 | 516.8365 | 433.9187 | 247.9660 | 115.5326 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 250.4678 | 460.4400 | 661.2438  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.5000  | 90.5000  | 90.5000   | (210)           |
| Space heating fuel (main heating system)                              | 719.4907 | 571.0901 | 479.4682 | 273.9956 | 127.6603 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 276.7601 | 508.7734 | 730.6561  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440  | (64)            |
| Efficiency of water heater (217)m                                     | 89.8332  | 89.7791  | 89.6536  | 89.3590  | 88.7884  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 89.3390  | 89.6983  | 87.3000   | (216)           |
| Fuel for water heating, kWh/month                                     | 184.0372 | 161.4895 | 167.9051 | 148.3310 | 144.3371 | 128.3171 | 120.5316 | 135.9979 | 136.9365 | 153.9883 | 165.5311 | 178.6670  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1826.0694 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3687.8945 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 345.4340  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5934.3979 | (238)           |

#### 10a. Fuel costs - using Table 12 prices

|                               | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|-------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1 | 3687.8945        | 3.4800              | 128.3387 (240)      |
| Space heating - secondary     | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)    | 1826.0694        | 3.4800              | 63.5472 (247)       |
| Pumps and fans for heating    | 75.0000          | 13.1900             | 9.8925 (249)        |
| Energy for lighting           | 345.4340         | 13.1900             | 45.5627 (250)       |
| Additional standing charges   |                  |                     | 120.0000 (251)      |
| Total energy cost             |                  |                     | 367.3412 (255)      |

#### 11a. SAP rating - Individual heating systems

|                                  |                                         |              |
|----------------------------------|-----------------------------------------|--------------|
| Energy cost deflator (Table 12): |                                         | 0.4200 (256) |
| Energy cost factor (ECF)         | $[(255) \times (256)] / [(4) + 45.0] =$ | 1.2343 (257) |
| SAP value                        |                                         | 82.7820      |
| SAP rating (Section 12)          |                                         | 83 (258)     |
| SAP band                         |                                         | B            |

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

|                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1 | 3687.8945          | 0.2160                        | 796.5852 (261)           |
| Space heating - secondary     | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)    | 1826.0694          | 0.2160                        | 394.4310 (264)           |
| Space and water heating       |                    |                               | 1191.0162 (265)          |
| Pumps and fans                | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting           | 345.4340           | 0.5190                        | 179.2802 (268)           |
| Total kg/year                 |                    |                               | 1409.2214 (272)          |
| CO2 emissions per m2          |                    |                               | 17.6200 (273)            |
| EI value                      |                    |                               | 84.8931                  |
| EI rating                     |                    |                               | 85 (274)                 |
| EI band                       |                    |                               | B                        |

#### Calculation of stars for heating and DHW

|                                    |                                                                     |
|------------------------------------|---------------------------------------------------------------------|
| Main heating energy efficiency     | $3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$ , stars = 4   |
| Main heating environmental impact  | $0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$ , stars = 4 |
| Water heating energy efficiency    | $3.48 / 0.8879 = 3.919$ , stars = 4                                 |
| Water heating environmental impact | $0.216 / 0.8879 = 0.2433$ , stars = 4                               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m3 per hour           |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-----------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)  |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)  |
| Number of intermittent fans                                               |                 |                      |                             |                 | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1934 (8)            |
| Pressure test                                                             |                 |                      |                             |                 | Yes                   |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0100                |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4439 (18)           |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0 (19)                |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 1.0000 (20)           |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.4439 (21)           |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.2000 | 4.0000 | 4.0000 | 3.7000 | 3.7000 | 3.3000 | 3.4000 | 3.2000 | 3.3000 | 3.5000 | 3.5000 | 3.8000 (22)  |
| Wind factor     | 1.0500 | 1.0000 | 1.0000 | 0.9250 | 0.9250 | 0.8250 | 0.8500 | 0.8000 | 0.8250 | 0.8750 | 0.8750 | 0.9500 (22a) |
| Adj infilt rate | 0.4661 | 0.4439 | 0.4439 | 0.4106 | 0.4106 | 0.3662 | 0.3773 | 0.3551 | 0.3662 | 0.3884 | 0.3884 | 0.4217 (22b) |
| Effective ac    | 0.6086 | 0.5985 | 0.5985 | 0.5843 | 0.5843 | 0.5671 | 0.5712 | 0.5631 | 0.5671 | 0.5754 | 0.5754 | 0.5889 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Door                                                  |                         |                            | 2.1300                    | 1.3000                        | 2.7690       |                                | (26)            |
| Window (Uw = 1.30)                                          |                         |                            | 14.7300                   | 1.2357                        | 18.2025      |                                | (27)            |
| French Door (Uw = 1.30)                                     |                         |                            | 3.3300                    | 1.2357                        | 4.1150       |                                | (27)            |
| GF B&B J150 P/A=0.40                                        |                         |                            | 40.0000                   | 0.1200                        | 4.8000       | 75.0000                        | 3000.0000 (28a) |
| EW Brick AAC015                                             | 135.9700                | 20.1900                    | 115.7800                  | 0.2500                        | 28.9450      | 52.3000                        | 6055.2940 (29a) |
| Plane Ceiling                                               | 40.0000                 |                            | 40.0000                   | 0.1600                        | 6.4000       | 9.0000                         | 360.0000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 215.9700                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 65.2315      |                                | (33)            |
| GF Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| 1F Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| Internal Floor                                              |                         |                            | 40.0000                   |                               |              | 18.0000                        | 720.0000 (32d)  |
| Internal Ceiling                                            |                         |                            | 47.0000                   |                               |              | 9.0000                         | 423.0000 (32e)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss  
(28)...(30) + (32) + (32a)...(32e) = 11908.2940 (34)  
148.8537 (35)  
7.0557 (36)  
(33) + (36) = 72.2872 (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                     | 41.5356  | 40.8464  | 40.8464  | 39.8755  | 39.8755  | 38.6988  | 38.9803  | 38.4256  | 38.6988  | 39.2703  | 39.2703  | 40.1907 (38)  |
| Heat transfer coeff       | 113.8228 | 113.1336 | 113.1336 | 112.1627 | 112.1627 | 110.9860 | 111.2676 | 110.7128 | 110.9860 | 111.5575 | 111.5575 | 112.4779 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 111.9967 (39) |
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| HLP                       | 1.4228   | 1.4142   | 1.4142   | 1.4020   | 1.4020   | 1.3873   | 1.3908   | 1.3839   | 1.3873   | 1.3945   | 1.3945   | 1.4060 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.4000 (40)   |
| Days in month             | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31 (41)       |

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

| Assumed occupancy                        |          |          |          |          |          |         |         |          |          |                    |          | 2.4629 (42)    |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 92.6930 (43)   |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 101.9622 | 98.2545  | 94.5468  | 90.8391  | 87.1314  | 83.4237 | 83.4237 | 87.1314  | 90.8391  | 94.5468            | 98.2545  | 101.9622 (44)  |
| Energy conte                             | 151.2071 | 132.2467 | 136.4667 | 118.9750 | 114.1593 | 98.5108 | 91.2848 | 104.7506 | 106.0017 | 123.5347           | 134.8478 | 146.4360 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1458.4211 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Distribution loss (46)m = 0.15 x (45)m                          | 22.6811  | 19.8370  | 20.4700  | 17.8462  | 17.1239  | 14.7766  | 13.6927  | 15.7126  | 15.9002  | 18.5302  | 20.2272  | 21.9654 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Total storage 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 (56)   |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 14.1195  | 12.7371  | 14.0662  | 13.5722  | 13.9953  | 13.5100  | 13.9393  | 13.9756  | 13.5439  | 14.0369  | 13.6308  | 14.1080 (61)  |
| Total heat required for water heating calculated for each month | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (64) |
| Heat gains from water heating, kWh/month                        | 53.8062  | 47.1563  | 48.8917  | 42.9522  | 41.4568  | 36.1324  | 33.8370  | 38.3235  | 38.6315  | 44.5845  | 48.2446  | 52.2170 (65)  |
| Solar input (sum of months) = Sum(63)m = 0.0000 (63)            |          |          |          |          |          |          |          |          |          |          |          |               |
| Total per year (kWh/year) = Sum(64)m = 1623.6559 (64)           |          |          |          |          |          |          |          |          |          |          |          |               |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 48.8998  | 43.4323  | 35.3215  | 26.7407  | 19.9890  | 16.8755  | 18.2346  | 23.7020  | 31.8128  | 40.3937  | 47.1454  | 50.2588 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 327.5232 | 330.9219 | 322.3573 | 304.1245 | 281.1088 | 259.4772 | 245.0260 | 241.6274 | 250.1919 | 268.4248 | 291.4405 | 313.0720 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 (71) |
| Water heating gains (Table 5)                                                       | 72.3202  | 70.1731  | 65.7147  | 59.6559  | 55.7215  | 50.1838  | 45.4799  | 51.5100  | 53.6549  | 59.9254  | 67.0064  | 70.1841 (72)  |
| Total internal gains                                                                | 553.2404 | 549.0245 | 527.8908 | 495.0183 | 461.3165 | 431.0338 | 413.2377 | 421.3367 | 440.1569 | 473.2411 | 510.0895 | 538.0122 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|-----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|
| North       |          |          |          |           | 7.4300     | 11.9814                        |           | 0.4600                            | 0.0000                             | 0.7700                       |          | 31.5316 (74)  |
| West        |          |          |          |           | 7.3000     | 22.3313                        |           | 0.4600                            | 0.0000                             | 0.7700                       |          | 57.7412 (80)  |
| West        |          |          |          |           | 3.3300     | 22.3313                        |           | 0.4600                            | 0.0000                             | 0.7700                       |          | 26.3395 (80)  |
| -----       |          |          |          |           |            |                                |           |                                   |                                    |                              |          |               |
| Solar gains | 115.6123 | 202.6573 | 333.0179 | 514.2921  | 631.1510   | 700.8003                       | 656.0868  | 562.9537                          | 423.7625                           | 257.1762                     | 147.3553 | 94.4410 (83)  |
| Total gains | 668.8527 | 751.6819 | 860.9087 | 1009.3104 | 1092.4675  | 1131.8342                      | 1069.3245 | 984.2904                          | 863.9193                           | 730.4173                     | 657.4448 | 632.4532 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 29.0615 | 29.2385 | 29.2385 | 29.4916 | 29.4916 | 29.8043 | 29.7289 | 29.8778 | 29.8043                   | 29.6516 | 29.6516 | 29.4090      |
| alpha                                                                       | 2.9374  | 2.9492  | 2.9492  | 2.9661  | 2.9661  | 2.9870  | 2.9819  | 2.9919  | 2.9870                    | 2.9768  | 2.9768  | 2.9606       |
| util living area                                                            | 0.9654  | 0.9506  | 0.9116  | 0.8202  | 0.6703  | 0.4587  | 0.3150  | 0.3489  | 0.6309                    | 0.8644  | 0.9458  | 0.9697 (86)  |
| MIT                                                                         | 19.1276 | 19.3433 | 19.7849 | 20.3255 | 20.7332 | 20.9420 | 20.9869 | 20.9824 | 20.8399                   | 20.3240 | 19.6580 | 19.1019 (87) |
| Th 2                                                                        | 19.7459 | 19.7525 | 19.7525 | 19.7618 | 19.7618 | 19.7731 | 19.7704 | 19.7757 | 19.7731                   | 19.7676 | 19.7676 | 19.7588 (88) |
| util rest of house                                                          | 0.9579  | 0.9399  | 0.8921  | 0.7810  | 0.6002  | 0.3578  | 0.1934  | 0.2203  | 0.5313                    | 0.8244  | 0.9319  | 0.9630 (89)  |
| MIT 2                                                                       | 17.3280 | 17.6404 | 18.2663 | 19.0091 | 19.5185 | 19.7403 | 19.7673 | 19.7712 | 19.6576                   | 19.0344 | 18.1066 | 17.2990 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1125 (91)  |
| MIT                                                                         | 17.5304 | 17.8320 | 18.4371 | 19.1572 | 19.6552 | 19.8755 | 19.9045 | 19.9074 | 19.7906                   | 19.1795 | 18.2811 | 17.5018 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |
| adjusted MIT                                                                | 17.3804 | 17.6820 | 18.2871 | 19.0072 | 19.5052 | 19.7255 | 19.7545 | 19.7574 | 19.6406                   | 19.0295 | 18.1311 | 17.3518 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
|                      | 0.9367    | 0.9148    | 0.8617    | 0.7523    | 0.5840   | 0.3536   | 0.1918   | 0.2183   | 0.5192   | 0.7937       | 0.9057    | 0.9435 (94)    |
| Useful gains         | 626.5085  | 687.6465  | 741.8474  | 759.3349  | 637.9575 | 400.2729 | 205.1146 | 214.8835 | 448.5264 | 579.7312     | 595.4377  | 596.7083 (95)  |
| Ext temp.            | 5.1000    | 5.6000    | 7.4000    | 9.9000    | 13.0000  | 16.0000  | 17.9000  | 17.8000  | 15.2000  | 11.6000      | 8.0000    | 5.1000 (96)    |
| Heat loss rate W     | 1397.7930 | 1366.8761 | 1231.6996 | 1021.4879 | 729.6396 | 413.4743 | 206.3492 | 216.7140 | 492.8454 | 828.8176     | 1130.2005 | 1378.0616 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating kWh    | 573.8357  | 456.4423  | 364.4500  | 188.7502  | 68.2114  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 185.3203     | 385.0292  | 581.3269 (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 2803.3660 (98) |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 35.0421 (99)   |

#### 8c. Space cooling requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Not applicable

#### 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 %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3097.6420 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 573.8357 | 456.4423 | 364.4500 | 188.7502 | 68.2114  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 185.3203 | 385.0292 | 581.3269  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.5000  | 90.5000  | 90.5000   | (210)           |
| Space heating fuel (main heating system)                              | 634.0726 | 504.3561 | 402.7072 | 208.5637 | 75.3718  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 204.7738 | 425.4467 | 642.3501  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546 | 112.0209 | 105.2241 | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440  | (64)            |
| Efficiency of water heater (217)m                                     | 89.7641  | 89.7073  | 89.5406  | 89.1519  | 88.3856  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 89.1084  | 89.5861  | 87.3000   | (216)           |
| Fuel for water heating, kWh/month                                     | 184.1790 | 161.6187 | 168.1169 | 148.6757 | 144.9949 | 128.3171 | 120.5316 | 135.9979 | 136.9365 | 154.3868 | 165.7384 | 178.8038  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1828.2974 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3097.6420 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 345.4340  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5346.3734 | (238)           |

#### 10a. Fuel costs - using BEDF prices (513)

|                               | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|-------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1 | 3097.6420        | 9.7400              | 301.7103 (240)      |
| Space heating - secondary     | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)    | 1828.2974        | 9.7400              | 178.0762 (247)      |
| Pumps and fans for heating    | 75.0000          | 36.8500             | 27.6375 (249)       |
| Energy for lighting           | 345.4340         | 36.8500             | 127.2924 (250)      |
| Additional standing charges   |                  |                     | 104.0000 (251)      |
| Total energy cost             |                  |                     | 738.7164 (255)      |

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

|                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1 | 3097.6420          | 0.2160                        | 669.0907 (261)           |
| Space heating - secondary     | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)    | 1828.2974          | 0.2160                        | 394.9122 (264)           |
| Space and water heating       |                    |                               | 1064.0029 (265)          |
| Pumps and fans                | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting           | 345.4340           | 0.5190                        | 179.2802 (268)           |
| Total kg/year                 |                    |                               | 1282.2081 (272)          |

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

|                               | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|-------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1 | 3097.6420          | 1.2200                              | 3779.1232 (261)            |
| Space heating - secondary     | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)    | 1828.2974          | 1.2200                              | 2230.5229 (264)            |
| Space and water heating       |                    |                                     | 6009.6461 (265)            |
| Pumps and fans                | 75.0000            | 3.0700                              | 230.2500 (267)             |
| Energy for lighting           | 345.4340           | 3.0700                              | 1060.4823 (268)            |
| Primary energy kWh/year       |                    |                                     | 7300.3784 (272)            |
| Primary energy kWh/m2/year    |                    |                                     | 91.2547 (273)              |

#### SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83  
Current environmental impact rating: B 85

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):

|                             |                   |
|-----------------------------|-------------------|
| A                           | Not considered    |
| B                           | Not considered    |
| C                           | Not considered    |
| D                           | Not considered    |
| E Low energy lighting       | Already installed |
| F                           | Not considered    |
| G                           | Not considered    |
| H                           | Not considered    |
| I                           | Not considered    |
| J                           | Not considered    |
| K                           | Not considered    |
| M                           | Not considered    |
| N Solar water heating       | Recommended       |
| O                           | Not considered    |
| P                           | Not considered    |
| R                           | Not considered    |
| S                           | Not considered    |
| T                           | Not considered    |
| U Solar photovoltaic panels | Recommended       |
| A2                          | Not considered    |
| A3                          | Not considered    |
| T2                          | Not considered    |
| W                           | Not considered    |
| X                           | Not considered    |
| Y                           | Not considered    |
| J2                          | Not considered    |
| Q2                          | Not considered    |
| Z1                          | Not considered    |
| Z2                          | Not considered    |
| Z3                          | Not considered    |
| Z4                          | Not considered    |
| Z5                          | Not considered    |
| V2 Wind turbine             | Not applicable    |
| L2                          | Not considered    |
| Q3                          | Not considered    |
| O3                          | Not considered    |

| Recommended measures:       | SAP change | Cost change | CO2 change      |
|-----------------------------|------------|-------------|-----------------|
| N Solar water heating       | + 1.2      | -£ 75       | -181 kg (14.1%) |
| U Solar photovoltaic panels | + 10.7     | -£ 672      | -947 kg (86.0%) |

| Recommended measures      | Typical annual savings | Energy efficiency | Environmental impact |
|---------------------------|------------------------|-------------------|----------------------|
| Solar water heating       | £75                    | 2.27 kg/m²        | B 84 B 87            |
| Solar photovoltaic panels | £672                   | 11.83 kg/m²       | A 95 A 96            |
| Total Savings             | £747                   | 14.10 kg/m²       |                      |

Potential energy efficiency rating: A 95  
 Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

| Typical heating and lighting costs of this home (per year, Thames Valley): |            |            |            |
|----------------------------------------------------------------------------|------------|------------|------------|
|                                                                            | Current    | Potential  | Saving     |
| Electricity                                                                | £155       | £173       | -£18       |
| Mains gas                                                                  | £584       | £490       | £93        |
| Space heating                                                              | £433       | £433       | £0         |
| Water heating                                                              | £178       | £103       | £75        |
| Lighting                                                                   | £127       | £127       | £0         |
| Generated (PV)                                                             | -£0        | -£672      | £672       |
| Total cost of fuels                                                        | £739       | -£9        | £747       |
| Total cost of uses                                                         | £738       | -£9        | £747       |
| Delivered energy                                                           | 67 kWh/m²  | 33 kWh/m²  | 34 kWh/m²  |
| Carbon dioxide emissions                                                   | 1.3 tonnes | 0.2 tonnes | 1.1 tonnes |
| CO2 emissions per m²                                                       | 16 kg/m²   | 2 kg/m²    | 14 kg/m²   |
| Primary energy                                                             | 91 kWh/m²  | 9 kWh/m²   | 83 kWh/m²  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m3 per hour           |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-----------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)  |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)  |
| Number of intermittent fans                                               |                 |                      |                             |                 | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1934 (8)            |
| Pressure test                                                             |                 |                      |                             |                 | Yes                   |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0100                |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4439 (18)           |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0 (19)                |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 1.0000 (20)           |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.4439 (21)           |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.5660 | 0.5549 | 0.5438 | 0.4883 | 0.4772 | 0.4217 | 0.4217 | 0.4106 | 0.4439 | 0.4772 | 0.4994 | 0.5216 (22b) |
|                 | 0.6602 | 0.6540 | 0.6479 | 0.6192 | 0.6139 | 0.5889 | 0.5889 | 0.5843 | 0.5985 | 0.6139 | 0.6247 | 0.6360 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Door                                                  |                         |                            | 2.1300                    | 1.3000                        | 2.7690       |                                | (26)            |
| Window (Uw = 1.30)                                          |                         |                            | 14.7300                   | 1.2357                        | 18.2025      |                                | (27)            |
| French Door (Uw = 1.30)                                     |                         |                            | 3.3300                    | 1.2357                        | 4.1150       |                                | (27)            |
| GF B&B J150 P/A=0.40                                        |                         |                            | 40.0000                   | 0.1200                        | 4.8000       | 75.0000                        | 3000.0000 (28a) |
| EW Brick AAC015                                             | 135.9700                | 20.1900                    | 115.7800                  | 0.2500                        | 28.9450      | 52.3000                        | 6055.2940 (29a) |
| Plane Ceiling                                               | 40.0000                 |                            | 40.0000                   | 0.1600                        | 6.4000       | 9.0000                         | 360.0000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 215.9700                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 65.2315      |                                | (33)            |
| GF Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| 1F Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| Internal Floor                                              |                         |                            | 40.0000                   |                               |              | 18.0000                        | 720.0000 (32d)  |
| Internal Ceiling                                            |                         |                            | 47.0000                   |                               |              | 9.0000                         | 423.0000 (32e)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss

|                                      |                 |
|--------------------------------------|-----------------|
| (28)...(30) + (32) + (32a)...(32e) = | 11908.2940 (34) |
|                                      | 148.8537 (35)   |
|                                      | 7.0557 (36)     |
| (33) + (36) =                        | 72.2872 (37)    |

|               |        |        |        |        |        |        |        |        |        |        |        |             |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
| HLP           | 1.4668 | 1.4615 | 1.4562 | 1.4318 | 1.4273 | 1.4060 | 1.4060 | 1.4020 | 1.4142 | 1.4273 | 1.4365 | 1.4462 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.4318 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

|               |            |            |            |            |            |            |            |            |            |            |            |                 |
|---------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------------|
| HLP           | Jan 1.4668 | Feb 1.4615 | Mar 1.4562 | Apr 1.4318 | May 1.4273 | Jun 1.4060 | Jul 1.4060 | Aug 1.4020 | Sep 1.4142 | Oct 1.4273 | Nov 1.4365 | Dec 1.4462 (40) |
| HLP (average) |            |            |            |            |            |            |            |            |            |            |            | 1.4318 (40)     |
| Days in month | 31         | 28         | 31         | 30         | 31         | 30         | 31         | 31         | 30         | 31         | 30         | 31 (41)         |

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

|                                          |              |             |             |             |             |             |             |             |             |                    |             |                   |
|------------------------------------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------|-------------|-------------------|
| Assumed occupancy                        |              |             |             |             |             |             |             |             |             |                    |             | 2.4629 (42)       |
| Average daily hot water use (litres/day) |              |             |             |             |             |             |             |             |             |                    |             | 92.6930 (43)      |
| Daily hot water use                      | Jan 101.9622 | Feb 98.2545 | Mar 94.5468 | Apr 90.8391 | May 87.1314 | Jun 83.4237 | Jul 83.4237 | Aug 87.1314 | Sep 90.8391 | Oct 94.5468        | Nov 98.2545 | Dec 101.9622 (44) |
| Energy conte                             | 151.2071     | 132.2467    | 136.4667    | 118.9750    | 114.1593    | 98.5108     | 91.2848     | 104.7506    | 106.0017    | 123.5347           | 134.8478    | 146.4360 (45)     |
| Energy content (annual)                  |              |             |             |             |             |             |             |             |             | Total = Sum(45)m = |             | 1458.4211 (45)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

|                                                                 |          |          |          |          |           |           |           |          |          |          |          |                 |
|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------------|
| Distribution loss (46)m = 0.15 x (45)m                          | 22.6811  | 19.8370  | 20.4700  | 17.8462  | 17.1239   | 14.7766   | 13.6927   | 15.7126  | 15.9002  | 18.5302  | 20.2272  | 21.9654 (46)    |
| Water storage loss:                                             |          |          |          |          |           |           |           |          |          |          |          |                 |
| Total storage 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 (56)     |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)     |
| Combi loss                                                      | 14.1195  | 12.7371  | 14.0662  | 13.5722  | 13.9953   | 13.5100   | 13.9393   | 13.9756  | 13.5439  | 14.0369  | 13.6308  | 14.1080 (61)    |
| Total heat required for water heating calculated for each month | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546  | 112.0209  | 105.2241  | 118.7262 | 119.5455 | 137.5716 | 148.4786 | 160.5440 (62)   |
| Aperture area of solar collector                                |          |          |          |          |           |           |           |          |          |          |          | 3.0000 (H1)     |
| Zero-loss collector efficiency                                  |          |          |          |          |           |           |           |          |          |          |          | 0.7000 (H2)     |
| Collector heat loss coefficient                                 |          |          |          |          |           |           |           |          |          |          |          | 1.8000 (H3)     |
| Collector 2nd order heat loss coefficient                       |          |          |          |          |           |           |           |          |          |          |          | 0.0050 (H3a)    |
| Collector effective heat loss coefficient                       |          |          |          |          |           |           |           |          |          |          |          | 1.8063 (H3b)    |
| Collector performance ratio                                     |          |          |          |          |           |           |           |          |          |          |          | 2.5804 (H4)     |
| Annual solar radiation per m2                                   |          |          |          |          |           |           |           |          |          |          |          | 1079.5246 (H5)  |
| Overshading factor                                              |          |          |          |          |           |           |           |          |          |          |          | 0.8000 (H6)     |
| Solar energy available                                          |          |          |          |          |           |           |           |          |          |          |          | 1813.6014 (H7)  |
| Adjustment factor for showers                                   |          |          |          |          |           |           |           |          |          |          |          | 1.0000 (H7a)    |
| Solar-to-load ratio                                             |          |          |          |          |           |           |           |          |          |          |          | 1.2435 (H8)     |
| Utilisation factor                                              |          |          |          |          |           |           |           |          |          |          |          | 0.5525 (H9)     |
| Collector performance factor                                    |          |          |          |          |           |           |           |          |          |          |          | 0.8793 (H10)    |
| Dedicated solar storage volume                                  |          |          |          |          |           |           |           |          |          |          |          | 75.0000 (H11)   |
| Effective solar volume                                          |          |          |          |          |           |           |           |          |          |          |          | 75.0000 (H13)   |
| Daily hot water demand                                          |          |          |          |          |           |           |           |          |          |          |          | 92.6930 (H14)   |
| Volume ratio Veff/V                                             |          |          |          |          |           |           |           |          |          |          |          | 0.8091 (H15)    |
| Solar storage volume factor                                     |          |          |          |          |           |           |           |          |          |          |          | 0.9576 (H16)    |
| Solar input                                                     |          |          |          |          |           |           |           |          |          |          |          | -843.7961 (H17) |
| Solar input                                                     | -24.4684 | -40.8307 | -69.5394 | -93.1965 | -115.1365 | -113.1975 | -111.7015 | -97.5942 | -76.4358 | -52.1967 | -29.0231 | -20.4759 (63)   |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |           |           |           |          |          |          |          | -843.7961 (63)  |
| Output from w/h                                                 | 140.8581 | 104.1531 | 80.9935  | 39.3506  | 13.0182   | 0.0000    | 0.0000    | 21.1320  | 43.1097  | 85.3749  | 119.4555 | 140.0681 (64)   |
| Total per year (kWh/year) = Sum (64)m =                         |          |          |          |          |           |           |           |          |          |          |          | 787.5138 (64)   |
| Heat gains from water heating, kWh/month                        | 53.8062  | 47.1563  | 48.8917  | 42.9522  | 41.4568   | 36.1324   | 33.8370   | 38.3235  | 38.6315  | 44.5845  | 48.2446  | 52.2170 (65)    |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      | (66) |
| (66)m                                                                               | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 48.8998  | 43.4323  | 35.3215  | 26.7407  | 19.9890  | 16.8755  | 18.2346  | 23.7020  | 31.8128  | 40.3937  | 47.1454  | 50.2588  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 327.5232 | 330.9219 | 322.3573 | 304.1245 | 281.1088 | 259.4772 | 245.0260 | 241.6274 | 250.1919 | 268.4248 | 291.4405 | 313.0720 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | (71) |
| Water heating gains (Table 5)                                                       | 72.3202  | 70.1731  | 65.7147  | 59.6559  | 55.7215  | 50.1838  | 45.4799  | 51.5100  | 53.6549  | 59.9254  | 67.0064  | 70.1841  | (72) |
| Total internal gains                                                                | 553.2404 | 549.0245 | 527.8908 | 495.0183 | 461.3165 | 431.0338 | 413.2377 | 421.3367 | 440.1569 | 473.2411 | 510.0895 | 538.0122 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d | Gains<br>W   |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|------------------------------|--------------|----------|---------------|
|             |          |          |          |            |                                |                                   |                                    |          |                              |              |          |               |
| North       |          |          |          | 7.4300     | 10.6334                        | 0.4600                            | 0.0000                             |          | 0.7700                       | 27.9840 (74) |          |               |
| West        |          |          |          | 7.3000     | 19.6403                        | 0.4600                            | 0.0000                             |          | 0.7700                       | 50.7830 (80) |          |               |
| West        |          |          |          | 3.3300     | 19.6403                        | 0.4600                            | 0.0000                             |          | 0.7700                       | 23.1654 (80) |          |               |
|             |          |          |          |            |                                |                                   |                                    |          |                              |              |          |               |
| Solar gains | 101.9324 | 198.1377 | 329.1061 | 493.4142   | 622.4404                       | 646.3909                          | 611.5146                           | 512.3873 | 386.3338                     | 235.3095     | 126.7269 | 84.1404 (83)  |
| Total gains | 655.1728 | 747.1622 | 856.9969 | 988.4324   | 1083.7568                      | 1077.4247                         | 1024.7524                          | 933.7240 | 826.4906                     | 708.5506     | 636.8163 | 622.1526 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |              | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |              |
| tau                                                                         | 28.1903 | 28.2926 | 28.3937 | 28.8781 | 28.9706 | 29.4090 | 29.4090 | 29.4916 | 29.2385                   | 28.9706 | 28.7841 | 28.5917      |              |
| alpha                                                                       | 2.8794  | 2.8862  | 2.8929  | 2.9252  | 2.9314  | 2.9606  | 2.9606  | 2.9661  | 2.9492                    | 2.9314  | 2.9189  | 2.9061       |              |
| util living area                                                            | 0.9712  | 0.9569  | 0.9255  | 0.8548  | 0.7380  | 0.5839  | 0.4523  | 0.5055  | 0.7251                    | 0.8978  | 0.9578  | 0.9749 (86)  |              |
| MIT                                                                         | 18.8946 | 19.1402 | 19.5706 | 20.1316 | 20.5789 | 20.8534 | 20.9492 | 20.9290 | 20.7077                   | 20.1142 | 19.4171 | 18.8617 (87) |              |
| Th 2                                                                        | 19.7125 | 19.7165 | 19.7205 | 19.7390 | 19.7425 | 19.7588 | 19.7588 | 19.7618 | 19.7525                   | 19.7425 | 19.7355 | 19.7281 (88) |              |
| util rest of house                                                          | 0.9650  | 0.9478  | 0.9094  | 0.8231  | 0.6810  | 0.4950  | 0.3367  | 0.3870  | 0.6447                    | 0.8681  | 0.9473  | 0.9695 (89)  |              |
| MIT 2                                                                       | 16.9715 | 17.3269 | 17.9429 | 18.7329 | 19.3184 | 19.6478 | 19.7345 | 19.7246 | 19.5008                   | 18.7334 | 17.7426 | 16.9332 (90) |              |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1125 (91)  |              |
| MIT                                                                         | 17.1879 | 17.5309 | 18.1260 | 18.8902 | 19.4602 | 19.7834 | 19.8712 | 19.8601 | 19.6366                   | 18.8887 | 17.9310 | 17.1501 (92) |              |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |              |
| adjusted MIT                                                                | 17.0379 | 17.3809 | 17.9760 | 18.7402 | 19.3102 | 19.6334 | 19.7212 | 19.7101 | 19.4866                   | 18.7387 | 17.7810 | 17.0001 (93) |              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov          | Dec       |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|-----------|-------|
| Utilisation          | 0.9455    | 0.9236    | 0.8795    | 0.7919    | 0.6585   | 0.4852   | 0.3330   | 0.3817   | 0.6247   | 0.8364   | 0.9233       | 0.9517    | (94)  |
| Useful gains         | 619.4817  | 690.1120  | 753.7272  | 782.7607  | 713.6457 | 522.7785 | 341.2437 | 356.3795 | 516.2833 | 592.6311 | 587.9535     | 592.1159  | (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     | 1494.6686 | 1459.2140 | 1336.9512 | 1127.1579 | 868.9314 | 566.1502 | 351.0645 | 371.2694 | 609.4003 | 929.2814 | 1227.4534    | 1480.8844 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000       | 1.0000    | (97a) |
| Space heating kWh    | 651.1391  | 516.8365  | 433.9187  | 247.9660  | 115.5326 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 250.4678 | 460.4400     | 661.2438  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |              | 3337.5445 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          | (98) / (4) = | 41.7193   | (99)  |

#### 8c. Space cooling requirement

Not applicable

#### 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 %)                      |          |          |          |          |          |         |         |         |         |            |          |          | 90.5000    | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |         |         |         |         |            |          |          | 0.0000     | (208)  |
| Space heating requirement                                             |          |          |          |          |          |         |         |         |         |            |          |          | 3687.8945  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct        | Nov      | Dec      |            |        |
| Space heating requirement                                             | 651.1391 | 516.8365 | 433.9187 | 247.9660 | 115.5326 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 250.4678   | 460.4400 | 661.2438 | (98)       |        |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 90.5000    | 90.5000  | 90.5000  | (210)      |        |
| Space heating fuel (main heating system)                              | 719.4907 | 571.0901 | 479.4682 | 273.9956 | 127.6603 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 276.7601   | 508.7734 | 730.6561 | (211)      |        |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 0.0000   | 0.0000   | (215)      |        |
| Water heating                                                         |          |          |          |          |          |         |         |         |         |            |          |          |            |        |
| Water heating requirement                                             | 140.8581 | 104.1531 | 80.9935  | 39.3506  | 13.0182  | 0.0000  | 0.0000  | 21.1320 | 43.1097 | 85.3749    | 119.4555 | 140.0681 | (64)       |        |
| Efficiency of water heater                                            | 89.9138  | 89.9470  | 89.9812  | 90.0479  | 90.1653  | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.6645    | 89.8218  | 89.9238  | (217)      |        |
| Fuel for water heating, kWh/month                                     | 156.6590 | 115.7938 | 90.0116  | 43.6997  | 14.4381  | 0.0000  | 0.0000  | 24.2062 | 49.3811 | 95.2160    | 132.9917 | 155.7630 | (219)      |        |
| Water heating fuel used                                               |          |          |          |          |          |         |         |         |         |            |          | 878.1603 | (219)      |        |
| Annual totals kWh/year                                                |          |          |          |          |          |         |         |         |         |            |          |          |            |        |
| Space heating fuel - main system                                      |          |          |          |          |          |         |         |         |         |            |          |          | 3687.8945  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |         |         |         |         |            |          |          | 0.0000     | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |         |         |         |         |            |          |          |            |        |
| central heating pump                                                  |          |          |          |          |          |         |         |         |         |            |          |          | 30.0000    | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |         |         |         |         |            |          |          | 45.0000    | (230e) |
| pump for solar water heating                                          |          |          |          |          |          |         |         |         |         |            |          |          | 50.0000    | (230g) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |         |         |         |         |            |          |          | 125.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |         |         |         |         |            |          |          | 345.4340   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |         |         |         |         |            |          |          |            |        |
| PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =                               |          |          |          |          |          |         |         |         |         | -1727.2394 |          |          | -1727.2394 | (233)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |         |         |         |         |            |          |          | 3309.2493  | (238)  |

#### 10a. Fuel costs - using Table 12 prices

|                                       | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |       |
|---------------------------------------|---------------|------------------|------------------|-------|
| Space heating - main system 1         | 3687.8945     | 3.4800           | 128.3387         | (240) |
| Space heating - secondary             | 0.0000        | 0.0000           | 0.0000           | (242) |
| Water heating (other fuel)            | 878.1603      | 3.4800           | 30.5600          | (247) |
| Pumps and fans for heating            | 75.0000       | 13.1900          | 9.8925           | (249) |
| Pump for solar water heating          | 50.0000       | 13.1900          | 6.5950           | (249) |
| Energy for lighting                   | 345.4340      | 13.1900          | 45.5627          | (250) |
| Additional standing charges           |               |                  | 120.0000         | (251) |
| Energy saving/generation technologies |               |                  |                  |       |
| PV Unit                               | -1727.2394    | 13.1900          | -227.8229        | (252) |
| Total energy cost                     |               |                  | 113.1261         | (255) |

#### 11a. SAP rating - Individual heating systems

|                                  |  |                                  |         |       |
|----------------------------------|--|----------------------------------|---------|-------|
| Energy cost deflator (Table 12): |  |                                  | 0.4200  | (256) |
| Energy cost factor (ECF)         |  | [(255) x (256)] / [(4) + 45.0] = | 0.3801  | (257) |
| SAP value                        |  |                                  | 94.6976 |       |
| SAP rating (Section 12)          |  |                                  | 95      | (258) |
| SAP band                         |  |                                  | A       |       |

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

| Energy | Emission factor | Emissions |
|--------|-----------------|-----------|
|--------|-----------------|-----------|

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

|                                       | kWh/year   | kg CO2/kWh | kg CO2/year     |
|---------------------------------------|------------|------------|-----------------|
| Space heating - main system 1         | 3687.8945  | 0.2160     | 796.5852 (261)  |
| Space heating - secondary             | 0.0000     | 0.0000     | 0.0000 (263)    |
| Water heating (other fuel)            | 878.1603   | 0.2160     | 189.6826 (264)  |
| Space and water heating               |            |            | 986.2678 (265)  |
| Pumps and fans                        | 125.0000   | 0.5190     | 64.8750 (267)   |
| Energy for lighting                   | 345.4340   | 0.5190     | 179.2802 (268)  |
| Energy saving/generation technologies |            |            |                 |
| PV Unit                               | -1727.2394 | 0.5190     | -896.4372 (269) |
| Total kg/year                         |            |            | 333.9858 (272)  |
| CO2 emissions per m2                  |            |            | 4.1700 (273)    |
| EI value                              |            |            | 96.4197         |
| EI rating                             |            |            | 96 (274)        |
| EI band                               |            |            | A               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 40.0000 (1b)              | x 2.5400 (2b)                   | = 101.6000 (1b) - (3b)      |
| First floor                                            | 40.0000 (1c)              | x 2.6300 (2c)                   | = 105.2000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 206.8000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m3 per hour           |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-----------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)  |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)  |
| Number of intermittent fans                                               |                 |                      |                             |                 | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1934 (8)            |
| Pressure test                                                             |                 |                      |                             |                 | Yes                   |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0100                |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4439 (18)           |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 0 (19)                |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 1.0000 (20)           |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.4439 (21)           |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.2000 | 4.0000 | 4.0000 | 3.7000 | 3.7000 | 3.3000 | 3.4000 | 3.2000 | 3.3000 | 3.5000 | 3.5000 | 3.8000 (22)  |
| Wind factor     | 1.0500 | 1.0000 | 1.0000 | 0.9250 | 0.9250 | 0.8250 | 0.8500 | 0.8000 | 0.8250 | 0.8750 | 0.8750 | 0.9500 (22a) |
| Adj infilt rate | 0.4661 | 0.4439 | 0.4439 | 0.4106 | 0.4106 | 0.3662 | 0.3773 | 0.3551 | 0.3662 | 0.3884 | 0.3884 | 0.4217 (22b) |
| Effective ac    | 0.6086 | 0.5985 | 0.5985 | 0.5843 | 0.5843 | 0.5671 | 0.5712 | 0.5631 | 0.5671 | 0.5754 | 0.5754 | 0.5889 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Solid Door                                                  |                         |                            | 2.1300                    | 1.3000                        | 2.7690       |                                | (26)            |
| Window (Uw = 1.30)                                          |                         |                            | 14.7300                   | 1.2357                        | 18.2025      |                                | (27)            |
| French Door (Uw = 1.30)                                     |                         |                            | 3.3300                    | 1.2357                        | 4.1150       |                                | (27)            |
| GF B&B J150 P/A=0.40                                        |                         |                            | 40.0000                   | 0.1200                        | 4.8000       | 75.0000                        | 3000.0000 (28a) |
| EW Brick AAC015                                             | 135.9700                | 20.1900                    | 115.7800                  | 0.2500                        | 28.9450      | 52.3000                        | 6055.2940 (29a) |
| Plane Ceiling                                               | 40.0000                 |                            | 40.0000                   | 0.1600                        | 6.4000       | 9.0000                         | 360.0000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 215.9700                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 65.2315      |                                | (33)            |
| GF Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| 1F Timber                                                   |                         |                            | 75.0000                   |                               |              | 9.0000                         | 675.0000 (32c)  |
| Internal Floor                                              |                         |                            | 40.0000                   |                               |              | 18.0000                        | 720.0000 (32d)  |
| Internal Ceiling                                            |                         |                            | 47.0000                   |                               |              | 9.0000                         | 423.0000 (32e)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss

|                                                                     |                                                                                                                                                      |
|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| (28)...(30) + (32) + (32a)...(32e) =                                | 11908.2940 (34)                                                                                                                                      |
| 148.8537 (35)                                                       |                                                                                                                                                      |
| 7.0557 (36)                                                         |                                                                                                                                                      |
| (33) + (36) =                                                       | 72.2872 (37)                                                                                                                                         |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                                                                                                                                                      |
| (38)m                                                               | Jan 41.5356 Feb 40.8464 Mar 40.8464 Apr 39.8755 May 39.8755 Jun 38.6988 Jul 38.9803 Aug 38.4256 Sep 38.6988 Oct 39.2703 Nov 39.2703 Dec 40.1907 (38) |
| Heat transfer coeff                                                 | 113.8228 113.1336 113.1336 112.1627 112.1627 110.9860 111.2676 110.7128 110.9860 111.5575 111.5575 112.4779 (39)                                     |
| Average = Sum(39)m / 12 =                                           | 111.9967 (39)                                                                                                                                        |
| HLP                                                                 | Jan 1.4228 Feb 1.4142 Mar 1.4142 Apr 1.4020 May 1.4020 Jun 1.3873 Jul 1.3908 Aug 1.3839 Sep 1.3873 Oct 1.3945 Nov 1.3945 Dec 1.4060 (40)             |
| HLP (average)                                                       | 1.4000 (40)                                                                                                                                          |
| Days in month                                                       | 31 28 31 30 31 30 31 31 30 31 30 31 (41)                                                                                                             |

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

|                                          |          |          |          |          |          |         |         |          |          |                    |          |                |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |          |          |                    |          | 2.4629 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 92.6930 (43)   |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 101.9622 | 98.2545  | 94.5468  | 90.8391  | 87.1314  | 83.4237 | 83.4237 | 87.1314  | 90.8391  | 94.5468            | 98.2545  | 101.9622 (44)  |
| Energy conte                             | 151.2071 | 132.2467 | 136.4667 | 118.9750 | 114.1593 | 98.5108 | 91.2848 | 104.7506 | 106.0017 | 123.5347           | 134.8478 | 146.4360 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1458.4211 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

|                                                                 |          |          |          |          |           |           |           |           |          |          |          |                 |
|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|----------|----------|-----------------|
| Distribution loss (46)m = 0.15 x (45)m                          | 22.6811  | 19.8370  | 20.4700  | 17.8462  | 17.1239   | 14.7766   | 13.6927   | 15.7126   | 15.9002  | 18.5302  | 20.2272  | 21.9654 (46)    |
| Water storage loss:                                             |          |          |          |          |           |           |           |           |          |          |          |                 |
| Total storage 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 (56)     |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)     |
| Combi loss                                                      | 14.1195  | 12.7371  | 14.0662  | 13.5722  | 13.9953   | 13.5100   | 13.9393   | 13.9756   | 13.5439  | 14.0369  | 13.6308  | 14.1080 (61)    |
| Total heat required for water heating calculated for each month | 165.3265 | 144.9838 | 150.5329 | 132.5472 | 128.1546  | 112.0209  | 105.2241  | 118.7262  | 119.5455 | 137.5716 | 148.4786 | 160.5440 (62)   |
| Aperture area of solar collector                                |          |          |          |          |           |           |           |           |          |          |          | 3.0000 (H1)     |
| Zero-loss collector efficiency                                  |          |          |          |          |           |           |           |           |          |          |          | 0.7000 (H2)     |
| Collector heat loss coefficient                                 |          |          |          |          |           |           |           |           |          |          |          | 1.8000 (H3)     |
| Collector 2nd order heat loss coefficient                       |          |          |          |          |           |           |           |           |          |          |          | 0.0050 (H3a)    |
| Collector effective heat loss coefficient                       |          |          |          |          |           |           |           |           |          |          |          | 1.8063 (H3b)    |
| Collector performance ratio                                     |          |          |          |          |           |           |           |           |          |          |          | 2.5804 (H4)     |
| Annual solar radiation per m2                                   |          |          |          |          |           |           |           |           |          |          |          | 1140.0998 (H5)  |
| Overshading factor                                              |          |          |          |          |           |           |           |           |          |          |          | 0.8000 (H6)     |
| Solar energy available                                          |          |          |          |          |           |           |           |           |          |          |          | 1915.3676 (H7)  |
| Adjustment factor for showers                                   |          |          |          |          |           |           |           |           |          |          |          | 1.0000 (H7a)    |
| Solar-to-load ratio                                             |          |          |          |          |           |           |           |           |          |          |          | 1.3133 (H8)     |
| Utilisation factor                                              |          |          |          |          |           |           |           |           |          |          |          | 0.5330 (H9)     |
| Collector performance factor                                    |          |          |          |          |           |           |           |           |          |          |          | 0.8793 (H10)    |
| Dedicated solar storage volume                                  |          |          |          |          |           |           |           |           |          |          |          | 75.0000 (H11)   |
| Effective solar volume                                          |          |          |          |          |           |           |           |           |          |          |          | 75.0000 (H13)   |
| Daily hot water demand                                          |          |          |          |          |           |           |           |           |          |          |          | 92.6930 (H14)   |
| Volume ratio Veff/V                                             |          |          |          |          |           |           |           |           |          |          |          | 0.8091 (H15)    |
| Solar storage volume factor                                     |          |          |          |          |           |           |           |           |          |          |          | 0.9576 (H16)    |
| Solar input                                                     |          |          |          |          |           |           |           |           |          |          |          | -859.6410 (H17) |
| Solar input                                                     | -26.4593 | -39.7683 | -66.9749 | -92.5798 | -111.4972 | -117.3459 | -114.5282 | -102.2744 | -79.8255 | -54.3038 | -32.1620 | -21.9217 (63)   |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |           |           |           |           |          |          |          | -859.6410 (63)  |
| Output from w/h                                                 | 138.8672 | 105.2155 | 83.5581  | 39.9674  | 16.6575   | 0.0000    | 0.0000    | 16.4518   | 39.7200  | 83.2678  | 116.3166 | 138.6223 (64)   |
| Total per year (kWh/year) = Sum (64)m =                         |          |          |          |          |           |           |           |           |          |          |          | 778.6441 (64)   |
| Heat gains from water heating, kWh/month                        | 53.8062  | 47.1563  | 48.8917  | 42.9522  | 41.4568   | 36.1324   | 33.8370   | 38.3235   | 38.6315  | 44.5845  | 48.2446  | 52.2170 (65)    |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      | (66) |
| (66)m                                                                               | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | 147.7717 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 48.8998  | 43.4323  | 35.3215  | 26.7407  | 19.9890  | 16.8755  | 18.2346  | 23.7020  | 31.8128  | 40.3937  | 47.1454  | 50.2588  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 327.5232 | 330.9219 | 322.3573 | 304.1245 | 281.1088 | 259.4772 | 245.0260 | 241.6274 | 250.1919 | 268.4248 | 291.4405 | 313.0720 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | 52.2400  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | -98.5144 | (71) |
| Water heating gains (Table 5)                                                       | 72.3202  | 70.1731  | 65.7147  | 59.6559  | 55.7215  | 50.1838  | 45.4799  | 51.5100  | 53.6549  | 59.9254  | 67.0064  | 70.1841  | (72) |
| Total internal gains                                                                | 553.2404 | 549.0245 | 527.8908 | 495.0183 | 461.3165 | 431.0338 | 413.2377 | 421.3367 | 440.1569 | 473.2411 | 510.0895 | 538.0122 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |              | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|----------|------------------------------|--------------|---------------|
| North       |          |          |          | 7.4300     | 11.9814                        |           | 0.4600                            | 0.0000                             |          | 0.7700                       | 31.5316 (74) |               |
| West        |          |          |          | 7.3000     | 22.3313                        |           | 0.4600                            | 0.0000                             |          | 0.7700                       | 57.7412 (80) |               |
| West        |          |          |          | 3.3300     | 22.3313                        |           | 0.4600                            | 0.0000                             |          | 0.7700                       | 26.3395 (80) |               |
|             |          |          |          |            |                                |           |                                   |                                    |          |                              |              |               |
| Solar gains | 115.6123 | 202.6573 | 333.0179 | 514.2921   | 631.1510                       | 700.8003  | 656.0868                          | 562.9537                           | 423.7625 | 257.1762                     | 147.3553     | 94.4410 (83)  |
| Total gains | 668.8527 | 751.6819 | 860.9087 | 1009.3104  | 1092.4675                      | 1131.8342 | 1069.3245                         | 984.2904                           | 863.9193 | 730.4173                     | 657.4448     | 632.4532 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |             |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|-------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |             |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |             |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |             |
| tau                                                                         | 29.0615 | 29.2385 | 29.2385 | 29.4916 | 29.4916 | 29.8043 | 29.7289 | 29.8778 | 29.8043                   | 29.6516 | 29.6516 | 29.4090      |             |
| alpha                                                                       | 2.9374  | 2.9492  | 2.9492  | 2.9661  | 2.9661  | 2.9870  | 2.9819  | 2.9919  | 2.9870                    | 2.9768  | 2.9768  | 2.9606       |             |
| util living area                                                            | 0.9654  | 0.9506  | 0.9116  | 0.8202  | 0.6703  | 0.4587  | 0.3150  | 0.3489  | 0.6309                    | 0.8644  | 0.9458  | 0.9697 (86)  |             |
| MIT                                                                         | 19.1276 | 19.3433 | 19.7849 | 20.3255 | 20.7332 | 20.9420 | 20.9869 | 20.9824 | 20.8399                   | 20.3240 | 19.6580 | 19.1019 (87) |             |
| Th 2                                                                        | 19.7459 | 19.7525 | 19.7525 | 19.7618 | 19.7618 | 19.7731 | 19.7704 | 19.7757 | 19.7731                   | 19.7676 | 19.7676 | 19.7588 (88) |             |
| util rest of house                                                          | 0.9579  | 0.9399  | 0.8921  | 0.7810  | 0.6002  | 0.3578  | 0.1934  | 0.2203  | 0.5313                    | 0.8244  | 0.9319  | 0.9630 (89)  |             |
| MIT 2                                                                       | 17.3280 | 17.6404 | 18.2663 | 19.0091 | 19.5185 | 19.7403 | 19.7673 | 19.7712 | 19.6576                   | 19.0344 | 18.1066 | 17.2990 (90) |             |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         |              | 0.1125 (91) |
| MIT                                                                         | 17.5304 | 17.8320 | 18.4371 | 19.1572 | 19.6552 | 19.8755 | 19.9045 | 19.9074 | 19.7906                   | 19.1795 | 18.2811 | 17.5018 (92) |             |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |             |
| adjusted MIT                                                                | 17.3804 | 17.6820 | 18.2871 | 19.0072 | 19.5052 | 19.7255 | 19.7545 | 19.7574 | 19.6406                   | 19.0295 | 18.1311 | 17.3518 (93) |             |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov          | Dec       |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|-----------|-------|
| Utilisation          | 0.9367    | 0.9148    | 0.8617    | 0.7523    | 0.5840   | 0.3536   | 0.1918   | 0.2183   | 0.5192   | 0.7937   | 0.9057       | 0.9435    | (94)  |
| Useful gains         | 626.5085  | 687.6465  | 741.8474  | 759.3349  | 637.9575 | 400.2729 | 205.1146 | 214.8835 | 448.5264 | 579.7312 | 595.4377     | 596.7083  | (95)  |
| Ext temp.            | 5.1000    | 5.6000    | 7.4000    | 9.9000    | 13.0000  | 16.0000  | 17.9000  | 17.8000  | 15.2000  | 11.6000  | 8.0000       | 5.1000    | (96)  |
| Heat loss rate W     | 1397.7930 | 1366.8761 | 1231.6996 | 1021.4879 | 729.6396 | 413.4743 | 206.3492 | 216.7140 | 492.8454 | 828.8176 | 1130.2005    | 1378.0616 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000       | 1.0000    | (97a) |
| Space heating kWh    | 573.8357  | 456.4423  | 364.4500  | 188.7502  | 68.2114  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 185.3203 | 385.0292     | 581.3269  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |              | 2803.3660 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |              | 35.0421   | (99)  |
|                      |           |           |           |           |          |          |          |          |          |          | (98) / (4) = |           |       |

#### 8c. Space cooling requirement

Not applicable

#### 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 %)                      |          |          |          |          |         |         |         |         |         |            |          |          | 90.5000    | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |         |         |         |         |         |            |          |          | 0.0000     | (208)  |
| Space heating requirement                                             |          |          |          |          |         |         |         |         |         |            |          |          | 3097.6420  | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct        | Nov      | Dec      |            |        |
| Space heating requirement                                             | 573.8357 | 456.4423 | 364.4500 | 188.7502 | 68.2114 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 185.3203   | 385.0292 | 581.3269 | (98)       |        |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 90.5000    | 90.5000  | 90.5000  | (210)      |        |
| Space heating fuel (main heating system)                              | 634.0726 | 504.3561 | 402.7072 | 208.5637 | 75.3718 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 204.7738   | 425.4467 | 642.3501 | (211)      |        |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 0.0000   | 0.0000   | (215)      |        |
| Water heating                                                         |          |          |          |          |         |         |         |         |         |            |          |          |            |        |
| Water heating requirement                                             | 138.8672 | 105.2155 | 83.5581  | 39.9674  | 16.6575 | 0.0000  | 0.0000  | 16.4518 | 39.7200 | 83.2678    | 116.3166 | 138.6223 | (64)       |        |
| Efficiency of water heater                                            | 89.8582  | 89.8828  | 89.8855  | 89.9240  | 89.8536 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.4831    | 89.7368  | 89.8657  | (217)      |        |
| Fuel for water heating, kWh/month                                     | 154.5403 | 117.0585 | 92.9606  | 44.4458  | 18.5385 | 0.0000  | 0.0000  | 18.8452 | 45.4983 | 93.0542    | 129.6196 | 154.2548 | (219)      |        |
| Water heating fuel used                                               |          |          |          |          |         |         |         |         |         |            |          | 868.8157 | (219)      |        |
| Annual totals kWh/year                                                |          |          |          |          |         |         |         |         |         |            |          |          |            |        |
| Space heating fuel - main system                                      |          |          |          |          |         |         |         |         |         |            |          |          | 3097.6420  | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |         |         |         |         |         |            |          |          | 0.0000     | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |         |         |         |         |         |            |          |          |            |        |
| central heating pump                                                  |          |          |          |          |         |         |         |         |         |            |          |          | 30.0000    | (230c) |
| main heating flue fan                                                 |          |          |          |          |         |         |         |         |         |            |          |          | 45.0000    | (230e) |
| pump for solar water heating                                          |          |          |          |          |         |         |         |         |         |            |          |          | 50.0000    | (230g) |
| Total electricity for the above, kWh/year                             |          |          |          |          |         |         |         |         |         |            |          |          | 125.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |         |         |         |         |         |            |          |          | 345.4340   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |         |         |         |         |         |            |          |          |            |        |
| PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =                               |          |          |          |          |         |         |         |         |         | -1824.1596 |          |          | -1824.1596 | (233)  |
| Total delivered energy for all uses                                   |          |          |          |          |         |         |         |         |         |            |          |          | 2612.7320  | (238)  |

#### 10a. Fuel costs - using BEDF prices (513)

|                                       | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |       |
|---------------------------------------|---------------|------------------|------------------|-------|
| Space heating - main system 1         | 3097.6420     | 9.7400           | 301.7103         | (240) |
| Space heating - secondary             | 0.0000        | 0.0000           | 0.0000           | (242) |
| Water heating (other fuel)            | 868.8157      | 9.7400           | 84.6227          | (247) |
| Pumps and fans for heating            | 75.0000       | 36.8500          | 27.6375          | (249) |
| Pump for solar water heating          | 50.0000       | 36.8500          | 18.4250          | (249) |
| Energy for lighting                   | 345.4340      | 36.8500          | 127.2924         | (250) |
| Additional standing charges           |               |                  | 104.0000         | (251) |
| Energy saving/generation technologies |               |                  |                  |       |
| PV Unit                               | -1824.1596    | 36.8500          | -672.2028        | (252) |
| Total energy cost                     |               |                  | -8.5149          | (255) |

#### 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         | 3097.6420       | 0.2160                     | 669.0907              | (261) |
| Space heating - secondary             | 0.0000          | 0.0000                     | 0.0000                | (263) |
| Water heating (other fuel)            | 868.8157        | 0.2160                     | 187.6642              | (264) |
| Space and water heating               |                 |                            | 856.7549              | (265) |
| Pumps and fans                        | 125.0000        | 0.5190                     | 64.8750               | (267) |
| Energy for lighting                   | 345.4340        | 0.5190                     | 179.2802              | (268) |
| Energy saving/generation technologies |                 |                            |                       |       |
| PV Unit                               | -1824.1596      | 0.5190                     | -946.7389             | (269) |
| Total kg/year                         |                 |                            | 154.1712              | (272) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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

|                                       | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1         | 3097.6420          | 1.2200                              | 3779.1232 (261)            |
| Space heating - secondary             | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)            | 868.8157           | 1.2200                              | 1059.9552 (264)            |
| Space and water heating               |                    |                                     | 4839.0784 (265)            |
| Pumps and fans                        | 125.0000           | 3.0700                              | 383.7500 (267)             |
| Energy for lighting                   | 345.4340           | 3.0700                              | 1060.4823 (268)            |
| Energy saving/generation technologies |                    |                                     |                            |
| PV Unit                               | -1824.1596         | 3.0700                              | -5600.1701 (269)           |
| Primary energy kWh/year               |                    |                                     | 683.1406 (272)             |
| Primary energy kWh/m2/year            |                    |                                     | 8.5393 (273)               |

#### SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

#### Overheating Calculation Input Data

|                                           |                                               |
|-------------------------------------------|-----------------------------------------------|
| Dwelling type                             | Detached House                                |
| Number of storeys                         | 2                                             |
| Cross ventilation possible                | Yes                                           |
| SAP Region                                | Thames Valley                                 |
| Front of dwelling faces                   | North                                         |
| Overshading                               | Average or unknown                            |
| Thermal mass parameter                    | 148.9 (calculated from construction elements) |
| Night ventilation                         | No                                            |
| Ventilation rate during hot weather (ach) | 4.00 (Windows half open)                      |

#### Overheating Calculation

|                                          |             |
|------------------------------------------|-------------|
| Summer ventilation heat loss coefficient | 272.98 (P1) |
| Transmission heat loss coefficient       | 72.29 (37)  |
| Summer heat loss coefficient             | 345.26 (P2) |

| Overhangs   | Ratio | Z_overhangs | Overhang type |
|-------------|-------|-------------|---------------|
| Orientation |       |             |               |
| North       | 0.000 | 1.000       | None          |
| West        | 0.000 | 1.000       | None          |

| Solar shading | Z blinds | Solar access | Z overhangs | Z summer   |
|---------------|----------|--------------|-------------|------------|
| Orientation   |          |              |             |            |
| North         | 1.000    | 0.90         | 1.000       | 0.900 (P8) |
| West          | 1.000    | 0.90         | 1.000       | 0.900 (P8) |

| [Jul] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Shading | Gains<br>W |
|-------|------------|--------------------------------|------------------------------|------------------------------------|---------|------------|
| North | 7.4300     | 81.1852                        | 0.4600                       | 0.0000                             | 0.9000  | 249.7272   |
| West  | 7.3000     | 117.5071                       | 0.4600                       | 0.0000                             | 0.9000  | 355.1299   |
| West  | 3.3300     | 117.5071                       | 0.4600                       | 0.0000                             | 0.9000  | 161.9976   |

total: 766.8547

|                                                  | Jun    | Jul    | Aug    |      |
|--------------------------------------------------|--------|--------|--------|------|
| Solar gains                                      | 819    | 767    | 658    | (P4) |
| Internal gains                                   | 428    | 410    | 418    |      |
| Total summer gains                               | 1247   | 1177   | 1076   | (P5) |
| Summer gain/loss ratio                           | 3.61   | 3.41   | 3.12   | (P6) |
| Summer external temperature                      | 16.00  | 17.90  | 17.80  |      |
| Thermal mass temperature increment (TMP = 148.9) | 0.96   | 0.96   | 0.96   |      |
| Threshold temperature                            | 20.57  | 22.27  | 21.88  | (P7) |
| Likelihood of high internal temperature          | Slight | Medium | Slight |      |

Assessment of likelihood of high internal temperature: Medium