

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                     |                |                 |
|------------------------------------|---------------------------------------------------------------------|----------------|-----------------|
| Property Reference                 | 1 Be Lean                                                           | Issued on Date | 05/05/2026      |
| Assessment Reference               | 001                                                                 | Prop Type Ref  | Westbury Avenue |
| Property                           |                                                                     |                |                 |
| SAP Rating                         | 83 B                                                                | DER            | 18.81           |
| Environmental                      | 85 B                                                                | TER            | 19.82           |
| CO <sub>2</sub> Emissions (t/year) | 1.24                                                                | % DER<TER      | 5.10            |
| General Requirements Compliance    | Fail                                                                | DFEE           | 57.99           |
|                                    |                                                                     | TTEE           | 62.69           |
|                                    |                                                                     | % DFEE<TFEE    | 7.50            |
| Assessor Details                   | Mr. Neil Ingham, The PES Ltd, Tel: 02071 486 292, neil@thepes.co.uk |                | Assessor ID     |
| Client                             |                                                                     |                | AV35-0001       |

### 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 (m <sup>2</sup> ) | Storey height (m)               | Volume (m <sup>3</sup> ) |
|--------------------------------------------------------|------------------------|---------------------------------|--------------------------|
| Basement floor                                         | 41.1400 (1a)           | x 2.4600 (2a)                   | = 101.2044 (1a) - (3a)   |
| Ground floor                                           | 35.5500 (1b)           | x 2.7600 (2b)                   | = 98.1180 (1b) - (3b)    |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 76.6900                |                                 | (4)                      |
| Dwelling volume                                        |                        | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 199.3224 (5)           |

#### 2. Ventilation rate

|                                                      | main heating                 |        | secondary heating |        | other  |        | total                       |         | m3 per hour |        |        |        |       |
|------------------------------------------------------|------------------------------|--------|-------------------|--------|--------|--------|-----------------------------|---------|-------------|--------|--------|--------|-------|
| Number of chimneys                                   | 0                            | +      | 0                 | +      | 0      | =      | 0 * 40 =                    | 0.0000  | (6a)        |        |        |        |       |
| Number of open flues                                 | 0                            | +      | 0                 | +      | 0      | =      | 0 * 20 =                    | 0.0000  | (6b)        |        |        |        |       |
| Number of intermittent fans                          |                              |        |                   |        |        |        | 3 * 10 =                    | 30.0000 | (7a)        |        |        |        |       |
| Number of passive vents                              |                              |        |                   |        |        |        | 0 * 10 =                    | 0.0000  | (7b)        |        |        |        |       |
| Number of flueless gas fires                         |                              |        |                   |        |        |        | 0 * 40 =                    | 0.0000  | (7c)        |        |        |        |       |
| Air changes per hour                                 |                              |        |                   |        |        |        |                             |         |             |        |        |        |       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |                   |        |        |        | 30.0000                     | / (5) = | 0.1505      | (8)    |        |        |       |
| Pressure test                                        |                              |        |                   |        |        |        | Yes                         |         | 4.0000      |        |        |        |       |
| Measured/design AP50                                 |                              |        |                   |        |        |        |                             |         | 0.3505      | (18)   |        |        |       |
| Infiltration rate                                    |                              |        |                   |        |        |        |                             |         | 2           | (19)   |        |        |       |
| Number of sides sheltered                            |                              |        |                   |        |        |        |                             |         |             |        |        |        |       |
| Shelter factor                                       |                              |        |                   |        |        |        | (20) = 1 - [0.075 x (19)] = |         | 0.8500      | (20)   |        |        |       |
| Infiltration rate adjusted to include shelter factor |                              |        |                   |        |        |        | (21) = (18) x (20) =        |         | 0.2979      | (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                                      | 0.3128                       | 0.2979 | 0.2979            | 0.2756 | 0.2756 | 0.2458 | 0.2532                      | 0.2383  | 0.2458      | 0.2607 | 0.2607 | 0.2830 | (22b) |
| Effective ac                                         | 0.5489                       | 0.5444 | 0.5444            | 0.5380 | 0.5380 | 0.5302 | 0.5321                      | 0.5284  | 0.5302      | 0.5340 | 0.5340 | 0.5401 | (25)  |

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

| Element                                                        | Gross m <sup>2</sup> | Openings m <sup>2</sup> | NetArea m <sup>2</sup> | U-value W/m <sup>2</sup> K | A x U W/K                            | K-value kJ/m <sup>2</sup> K | A x K kJ/K      |
|----------------------------------------------------------------|----------------------|-------------------------|------------------------|----------------------------|--------------------------------------|-----------------------------|-----------------|
| G (Uw = 1.40)                                                  |                      |                         | 18.9400                | 1.3258                     | 25.1098                              |                             | (27)            |
| D                                                              |                      |                         | 2.0700                 | 1.4000                     | 2.8980                               |                             | (26)            |
| RL (Uw = 1.40)                                                 |                      |                         | 14.0500                | 1.3258                     | 18.6269                              |                             | (27a)           |
| BF                                                             |                      |                         | 39.6400                | 0.1800                     | 7.1352                               | 110.0000                    | 4360.4000 (28)  |
| EF                                                             |                      |                         | 1.5000                 | 0.1800                     | 0.2700                               | 110.0000                    | 165.0000 (28a)  |
| EW                                                             | 157.4000             | 21.0100                 | 136.3900               | 0.2000                     | 27.2780                              | 60.0000                     | 8183.4000 (29a) |
| FR                                                             | 42.6400              | 14.0500                 | 28.5900                | 0.1500                     | 4.2885                               | 9.0000                      | 257.3100 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                      |                         | 241.1800               |                            |                                      |                             | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                      |                         |                        | (26)...(30) + (32) =       | 85.6064                              |                             | (33)            |
| Internal Wall 1                                                |                      |                         | 115.0500               |                            |                                      | 9.0000                      | 1035.4500 (32c) |
| Internal Floor 1                                               |                      |                         | 34.0500                |                            |                                      | 18.0000                     | 612.9000 (32d)  |
| Internal Ceiling 1                                             |                      |                         | 34.0500                |                            |                                      | 18.0000                     | 612.9000 (32e)  |
| Heat capacity Cm = Sum (A x k)                                 |                      |                         |                        |                            | (28)...(30) + (32) + (32a)...(32e) = |                             | 15227.3600 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                      |                         |                        |                            |                                      |                             | 198.5573 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                      |                         |                        |                            |                                      |                             | 10.1659 (36)    |
| Total fabric heat loss                                         |                      |                         |                        |                            |                                      | (33) + (36) =               | 95.7724 (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 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

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### CALCULATION OF HEAT DEMAND 09 Jan 2014

|                           |          |          |          |          |          |          |          |          |          |          |          |               |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 36.1067  | 35.8075  | 35.8075  | 35.3860  | 35.3860  | 34.8751  | 34.9974  | 34.7565  | 34.8751  | 35.1233  | 35.1233  | 35.5229 (38)  |
| Heat transfer coeff       | 131.8791 | 131.5799 | 131.5799 | 131.1584 | 131.1584 | 130.6475 | 130.7698 | 130.5289 | 130.6475 | 130.8957 | 130.8957 | 131.2952 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 131.0863 (39) |
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| HLP                       | 1.7196   | 1.7157   | 1.7157   | 1.7102   | 1.7102   | 1.7036   | 1.7052   | 1.7020   | 1.7036   | 1.7068   | 1.7068   | 1.7120 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.7093 (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                                               |          |          |          |          |          |          |          |          |          |                    |          | 2.3971 (42)    |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |                    |          | 91.1301 (43)   |
|                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                                             | 100.2431 | 96.5979  | 92.9527  | 89.3075  | 85.6623  | 82.0171  | 82.0171  | 85.6623  | 89.3075  | 92.9527            | 96.5979  | 100.2431 (44)  |
| Energy conte                                                    | 148.6576 | 130.0169 | 134.1658 | 116.9690 | 112.2346 | 96.8499  | 89.7457  | 102.9845 | 104.2144 | 121.4519           | 132.5742 | 143.9670 (45)  |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 1433.8314 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          | 22.2986  | 19.5025  | 20.1249  | 17.5454  | 16.8352  | 14.5275  | 13.4618  | 15.4477  | 15.6322  | 18.2178            | 19.8861  | 21.5950 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                    |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                    |          | 170.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                    |          | 1.2000 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                    |          | 0.6480 (55)    |
| Total storage loss                                              | 20.0880  | 18.1440  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880  | 19.4400  | 20.0880            | 19.4400  | 20.0880 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                    |          |                |
| Primary loss                                                    | 20.0880  | 18.1440  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880  | 19.4400  | 20.0880            | 19.4400  | 20.0880 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624            | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 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                                                 | 192.0080 | 169.1721 | 177.5162 | 158.9210 | 155.5850 | 138.8019 | 133.0961 | 146.3349 | 146.1664 | 164.8023           | 174.5262 | 187.3174 (62)  |
| RHI water heating demand                                        |          |          |          |          |          |          |          |          |          |                    |          | 1944.2474 (64) |
| Heat gains from water heating, kWh/month                        | 84.1090  | 74.5548  | 79.2905  | 72.4538  | 71.9983  | 65.7642  | 64.5208  | 68.9227  | 68.2129  | 75.0631            | 77.6425  | 82.5493 (65)   |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 47.3355  | 42.0429  | 34.1916  | 25.8853  | 19.3495  | 16.3357  | 17.6513  | 22.9438  | 30.7951  | 39.1015  | 45.6372  | 48.6511 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 316.9910 | 320.2804 | 311.9912 | 294.3447 | 272.0691 | 251.1332 | 237.1467 | 233.8573 | 242.1464 | 259.7930 | 282.0686 | 303.0045 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794 (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)                                 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 (71) |
| Water heating gains (Table 5)                                                       | 113.0497 | 110.9446 | 106.5732 | 100.6303 | 96.7719  | 91.3391  | 86.7214  | 92.6380  | 94.7401  | 100.8912 | 107.8368 | 110.9534 (72) |
| Total internal gains                                                                | 580.0967 | 575.9885 | 555.4766 | 523.5808 | 490.9111 | 461.5285 | 444.2399 | 452.1596 | 470.4022 | 502.5062 | 538.2632 | 565.3295 (73) |

#### 6. Solar gains

| [Jan]       |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |           |           |           |               |
|-------------|----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|-----------|-----------|-----------|---------------|
| Northeast   |          |           | 1.1300     | 12.9236                        | 0.6300                            | 0.7000                             | 0.7700                       | 4.4631 (75)   |           |           |           |               |
| Southeast   |          |           | 14.0500    | 40.4699                        | 0.6300                            | 0.7000                             | 0.7700                       | 173.7723 (77) |           |           |           |               |
| Southwest   |          |           | 3.7600     | 40.4699                        | 0.6300                            | 0.7000                             | 0.7700                       | 46.5042 (79)  |           |           |           |               |
| Northeast   |          |           | 14.0500    | 30.0000                        | 0.6300                            | 0.7000                             | 1.0000                       | 167.2934 (82) |           |           |           |               |
| Solar gains | 392.0328 | 658.0360  | 1018.1107  | 1486.6493                      | 1763.0511                         | 1932.1514                          | 1818.8873                    | 1601.5690     | 1264.7595 | 816.2422  | 493.4959  | 324.1716 (83) |
| Total gains | 972.1295 | 1234.0244 | 1573.5873  | 2010.2301                      | 2253.9622                         | 2393.6799                          | 2263.1272                    | 2053.7286     | 1735.1618 | 1318.7484 | 1031.7591 | 889.5012 (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                                                                         | 32.0735 | 32.1464 | 32.1464 | 32.2497 | 32.2497 | 32.3758 | 32.3456 | 32.4052 | 32.3758 | 32.3145 | 32.3145 | 32.2161      |
| alpha                                                                       | 3.1382  | 3.1431  | 3.1431  | 3.1500  | 3.1500  | 3.1584  | 3.1564  | 3.1603  | 3.1584  | 3.1543  | 3.1543  | 3.1477       |
| util living area                                                            | 0.9499  | 0.9056  | 0.8050  | 0.6263  | 0.4422  | 0.2696  | 0.1785  | 0.2023  | 0.4181  | 0.7323  | 0.9071  | 0.9597 (86)  |
| MIT                                                                         | 19.7689 | 20.0268 | 20.4037 | 20.7220 | 20.8630 | 20.9070 | 20.9132 | 20.9127 | 20.8832 | 20.6557 | 20.1655 | 19.7084 (87) |

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|                        |         |         |         |         |         |         |         |         |                           |         |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Th 2                   | 19.5268 | 19.5296 | 19.5296 | 19.5335 | 19.5335 | 19.5383 | 19.5371 | 19.5394 | 19.5383                   | 19.5360 | 19.5360 | 19.5322 (88) |
| util rest of house     | 0.9366  | 0.8831  | 0.7640  | 0.5653  | 0.3688  | 0.1923  | 0.0945  | 0.1105  | 0.3202                    | 0.6624  | 0.8801  | 0.9487 (89)  |
| MIT 2                  | 17.9830 | 18.3410 | 18.8407 | 19.2261 | 19.3715 | 19.4104 | 19.4120 | 19.4143 | 19.3972                   | 19.1742 | 18.5483 | 17.9023 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1623 (91)  |
| MIT                    | 18.2729 | 18.6147 | 19.0945 | 19.4689 | 19.6136 | 19.6534 | 19.6557 | 19.6575 | 19.6385                   | 19.4147 | 18.8108 | 18.1955 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |
| adjusted MIT           | 18.1229 | 18.4647 | 18.9445 | 19.3189 | 19.4636 | 19.5034 | 19.5057 | 19.5075 | 19.4885                   | 19.2647 | 18.6608 | 18.0455 (93) |

#### 8. Space heating requirement

|                          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec            |  |
|--------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|----------------|--|
| Utilisation              | 0.9196    | 0.8625    | 0.7451    | 0.5556    | 0.3651   | 0.1904   | 0.0927   | 0.1084   | 0.3167   | 0.6476    | 0.8593    | 0.9334 (94)    |  |
| Useful gains             | 893.9967  | 1064.4000 | 1172.4523 | 1116.9348 | 823.0266 | 455.7126 | 209.8737 | 222.7048 | 549.5035 | 854.0307  | 886.6161  | 830.2348 (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         | 1717.4502 | 1692.7350 | 1519.0172 | 1235.3727 | 847.7567 | 457.7062 | 209.9786 | 222.8827 | 560.2795 | 1003.2769 | 1395.4551 | 1699.6864 (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        | 612.6494  | 422.2411  | 257.8443  | 85.2753   | 18.3992  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 111.0392  | 366.3641  | 646.8720 (98)  |  |
| Space heating            |           |           |           |           |          |          |          |          |          |           |           | 2520.6845 (98) |  |
| RHI space heating demand |           |           |           |           |          |          |          |          |          |           |           | 2521 (98)      |  |

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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> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Basement floor                                         | 41.1400 (1a)              | x 2.4600 (2a)                   | = 101.2044 (1a) - (3a)      |
| Ground floor                                           | 35.5500 (1b)              | x 2.7600 (2b)                   | = 98.1180 (1b) - (3b)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 76.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 199.3224 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 30.0000 / (5) = 0.1505 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 4.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3505 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.2979 (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 | 0.3799 | 0.3724 | 0.3650 | 0.3277 | 0.3203 | 0.2830 | 0.2830 | 0.2756 | 0.2979 | 0.3203 | 0.3352 | 0.3501 (22b) |
| Effective ac    | 0.5721 | 0.5693 | 0.5666 | 0.5537 | 0.5513 | 0.5401 | 0.5401 | 0.5380 | 0.5444 | 0.5513 | 0.5562 | 0.5613 (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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| G (Uw = 1.40)                                                  |                         |                            | 18.9400                   | 1.3258                        | 25.1098      |                                      | (27)            |
| D                                                              |                         |                            | 2.0700                    | 1.4000                        | 2.8980       |                                      | (26)            |
| RL (Uw = 1.40)                                                 |                         |                            | 14.0500                   | 1.3258                        | 18.6269      |                                      | (27a)           |
| BF                                                             |                         |                            | 39.6400                   | 0.1800                        | 7.1352       | 110.0000                             | 4360.4000 (28)  |
| EF                                                             |                         |                            | 1.5000                    | 0.1800                        | 0.2700       | 110.0000                             | 165.0000 (28a)  |
| EW                                                             | 157.4000                | 21.0100                    | 136.3900                  | 0.2000                        | 27.2780      | 60.0000                              | 8183.4000 (29a) |
| FR                                                             | 42.6400                 | 14.0500                    | 28.5900                   | 0.1500                        | 4.2885       | 9.0000                               | 257.3100 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 241.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 85.6064      |                                      | (33)            |
| Internal Wall 1                                                |                         |                            | 115.0500                  |                               |              | 9.0000                               | 1035.4500 (32c) |
| Internal Floor 1                                               |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 15227.3600 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 198.5573 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 10.1659 (36)    |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 95.7724 (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                     | 37.6339  | 37.4496  | 37.2690  | 36.4205  | 36.2618  | 35.5229  | 35.5229  | 35.3860  | 35.8075  | 36.2618  | 36.5829  | 36.9187 (38)  |
| Heat transfer coeff       | 133.4063 | 133.2220 | 133.0413 | 132.1929 | 132.0342 | 131.2952 | 131.2952 | 131.1584 | 131.5799 | 132.0342 | 132.3553 | 132.6910 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 132.1922 (39) |
| HLP                       | 1.7396   | 1.7371   | 1.7348   | 1.7237   | 1.7217   | 1.7120   | 1.7120   | 1.7102   | 1.7157   | 1.7217   | 1.7258   | 1.7302 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.7237 (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                        |          |          |          |          |          |         |         |          |          |                    |          | 2.3971 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 91.1301 (43)   |
| Jan                                      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug     | Sep      | Oct      | Nov                | Dec      |                |
| Daily hot water use                      | 100.2431 | 96.5979  | 92.9527  | 89.3075  | 85.6623  | 82.0171 | 82.0171 | 85.6623  | 89.3075  | 92.9527            | 96.5979  | 100.2431 (44)  |
| Energy conte                             | 148.6576 | 130.0169 | 134.1658 | 116.9690 | 112.2346 | 96.8499 | 89.7457 | 102.9845 | 104.2144 | 121.4519           | 132.5742 | 143.9670 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1433.8314 (45) |

# FULL SAP CALCULATION PRINTOUT

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### CALCULATION OF ENERGY RATINGS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                  |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------------|
| Distribution loss (46)m = 0.15 x (45)m                          | 22.2986  | 19.5025  | 20.1249  | 17.5454  | 16.8352  | 14.5275  | 13.4618  | 15.4477  | 15.6322  | 18.2178  | 19.8861  | 21.5950 (46)     |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                  |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 170.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 1.2000 (48)      |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)      |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.6480 (55)      |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                  |
| 20.0880                                                         | 18.1440  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880 (56)     |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                  |
| 20.0880                                                         | 18.1440  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880 (57)     |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)     |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                  |
| 192.0080                                                        | 169.1721 | 177.5162 | 158.9210 | 155.5850 | 138.8019 | 133.0961 | 146.3349 | 146.1664 | 164.8023 | 174.5262 | 187.3174 | 187.3174 (62)    |
| WWHRS                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 eq. (G10) |
| Total of WWHRS savings                                          |          |          |          |          |          |          |          |          |          |          |          | 0.0000           |
| 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                                                 |          |          |          |          |          |          |          |          |          |          |          |                  |
| 192.0080                                                        | 169.1721 | 177.5162 | 158.9210 | 155.5850 | 138.8019 | 133.0961 | 146.3349 | 146.1664 | 164.8023 | 174.5262 | 187.3174 | 187.3174 (64)    |
| Heat gains from water heating, kWh/month                        | 84.1090  | 74.5548  | 79.2905  | 72.4538  | 71.9983  | 65.7642  | 64.5208  | 68.9227  | 68.2129  | 75.0631  | 77.6425  | 82.5493 (65)     |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 47.3355  | 42.0429  | 34.1916  | 25.8853  | 19.3495  | 16.3357  | 17.6513  | 22.9438  | 30.7951  | 39.1015  | 45.6372  | 48.6511  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 316.9910 | 320.2804 | 311.9912 | 294.3447 | 272.0691 | 251.1332 | 237.1467 | 233.8573 | 242.1464 | 259.7930 | 282.0686 | 303.0045 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | (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)                                 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | (71) |
| Water heating gains (Table 5)                                                       | 113.0497 | 110.9446 | 106.5732 | 100.6303 | 96.7719  | 91.3391  | 86.7214  | 92.6380  | 94.7401  | 100.8912 | 107.8368 | 110.9534 | (72) |
| Total internal gains                                                                | 580.0967 | 575.9885 | 555.4766 | 523.5808 | 490.9111 | 461.5285 | 444.2399 | 452.1596 | 470.4022 | 502.5062 | 538.2632 | 565.3295 | (73) |

#### 6. Solar gains

| [Jan]       |          |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c |           | Access<br>factor<br>Table 6d | Gains<br>W    |               |
|-------------|----------|-----------|-----------|------------|--------------------------------|-----------------------------------|-----------|------------------------------------|-----------|------------------------------|---------------|---------------|
| Northeast   |          |           |           | 1.1300     | 11.2829                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       | 3.8965 (75)   |               |
| Southeast   |          |           |           | 14.0500    | 36.7938                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       | 157.9877 (77) |               |
| Southwest   |          |           |           | 3.7600     | 36.7938                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       | 42.2800 (79)  |               |
| Northeast   |          |           |           | 14.0500    | 26.0000                        | 0.6300                            |           | 0.7000                             |           | 1.0000                       | 144.9876 (82) |               |
| -----       |          |           |           |            |                                |                                   |           |                                    |           |                              |               |               |
| Solar gains | 349.1517 | 650.1893  | 1016.3774 | 1438.2592  | 1749.9946                      | 1792.0072                         | 1705.4139 | 1468.7770                          | 1164.0938 | 754.7594                     | 428.7999      | 291.6748 (83) |
| Total gains | 929.2484 | 1226.1778 | 1571.8539 | 1961.8399  | 2240.9057                      | 2253.5357                         | 2149.6538 | 1920.9366                          | 1634.4960 | 1257.2656                    | 967.0631      | 857.0043 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |                           |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |                           |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |                           |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec          |
| tau                                                                         | 31.7063 | 31.7502 | 31.7933 | 31.9973 | 32.0358 | 32.2161 | 32.2161 | 32.2497 | 32.1464 | 32.0358                   | 31.9581 | 31.8772      |
| alpha                                                                       | 3.1138  | 3.1167  | 3.1196  | 3.1332  | 3.1357  | 3.1477  | 3.1477  | 3.1500  | 3.1431  | 3.1357                    | 3.1305  | 3.1251       |
| util living area                                                            | 0.9606  | 0.9167  | 0.8285  | 0.6760  | 0.5070  | 0.3622  | 0.2656  | 0.3084  | 0.5128  | 0.7905                    | 0.9319  | 0.9684 (86)  |
| MIT                                                                         | 19.6154 | 19.9207 | 20.3037 | 20.6475 | 20.8246 | 20.8910 | 20.9078 | 20.9039 | 20.8463 | 20.5441                   | 19.9991 | 19.5509 (87) |
| Th 2                                                                        | 19.5126 | 19.5143 | 19.5160 | 19.5239 | 19.5253 | 19.5322 | 19.5322 | 19.5335 | 19.5296 | 19.5253                   | 19.5224 | 19.5192 (88) |
| util rest of house                                                          | 0.9504  | 0.8970  | 0.7926  | 0.6206  | 0.4382  | 0.2833  | 0.1784  | 0.2126  | 0.4182  | 0.7331                    | 0.9120  | 0.9600 (89)  |
| MIT 2                                                                       | 17.7537 | 18.1811 | 18.6971 | 19.1309 | 19.3264 | 19.3938 | 19.4049 | 19.4047 | 19.3600 | 19.0328                   | 18.3081 | 17.6669 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.1623 (91)  |
| MIT                                                                         | 18.0559 | 18.4635 | 18.9579 | 19.3771 | 19.5696 | 19.6369 | 19.6489 | 19.6481 | 19.6013 | 19.2781                   | 18.5827 | 17.9728 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | -0.1500      |
| adjusted MIT                                                                | 17.9059 | 18.3135 | 18.8079 | 19.2271 | 19.4196 | 19.4869 | 19.4989 | 19.4981 | 19.4513 | 19.1281                   | 18.4327 | 17.8228 (93) |

#### 8. Space heating requirement

|                   | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec            |
|-------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|----------------|
| Utilisation       | 0.9352    | 0.8768    | 0.7725    | 0.6084    | 0.4330    | 0.2808   | 0.1764   | 0.2103   | 0.4129   | 0.7149    | 0.8926    | 0.9465 (94)    |
| Useful gains      | 869.0248  | 1075.1624 | 1214.2701 | 1193.5109 | 970.3895  | 632.7753 | 379.2635 | 403.9315 | 674.8214 | 898.8223  | 863.1591  | 811.1473 (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  | 1815.1144 | 1786.9743 | 1637.4641 | 1365.1734 | 1019.2521 | 641.6218 | 380.6107 | 406.3375 | 704.1195 | 1126.0022 | 1499.9367 | 1807.6198 (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 | 703.8907  | 478.3376  | 314.8564  | 123.5970  | 36.3538   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 169.0219  | 458.4798  | 741.3755 (98)  |

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Space heating 3025.9126 (98)  
Space heating per m2 (98) / (4) = 39.4564 (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 %) 96.3000 (206)  
Efficiency of secondary/supplementary heating system, % 0.0000 (208)  
Space heating requirement 3142.1731 (211)

|                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
|-----------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Space heating requirement                           | 703.8907 | 478.3376 | 314.8564 | 123.5970 | 36.3538  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 169.0219 | 458.4798 | 741.3755 (98)   |
| Space heating efficiency (main heating system 1)    | 96.3000  | 96.3000  | 96.3000  | 96.3000  | 96.3000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 96.3000  | 96.3000  | 96.3000 (210)   |
| Space heating fuel (main heating system)            | 730.9353 | 496.7161 | 326.9537 | 128.3458 | 37.7505  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 175.5160 | 476.0954 | 769.8604 (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                           | 192.0080 | 169.1721 | 177.5162 | 158.9210 | 155.5850 | 138.8019 | 133.0961 | 146.3349 | 146.1664 | 164.8023 | 174.5262 | 187.3174 (64)   |
| Efficiency of water heater (217)m                   | 90.7797  | 90.2457  | 89.1370  | 86.9631  | 84.4340  | 82.6000  | 82.6000  | 82.6000  | 82.6000  | 87.6920  | 90.0827  | 82.6000 (216)   |
| Fuel for water heating, kWh/month                   | 211.5099 | 187.4573 | 199.1499 | 182.7453 | 184.2681 | 168.0410 | 161.1332 | 177.1608 | 176.9569 | 187.9331 | 193.7401 | 206.0146 (219)  |
| Water heating fuel used                             |          |          |          |          |          |          |          |          |          |          |          | 2236.1102 (219) |
| Annual totals kWh/year                              |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                    |          |          |          |          |          |          |          |          |          |          |          | 3142.1731 (211) |
| Space heating fuel - secondary                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                     |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| Total electricity for the above, kWh/year           |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (231)   |
| Electricity for lighting (calculated in Appendix L) |          |          |          |          |          |          |          |          |          |          |          | 334.3836 (232)  |
| Total delivered energy for all uses                 |          |          |          |          |          |          |          |          |          |          |          | 5742.6669 (238) |

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

|                               | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|-------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 3142.1731     | 3.4800           | 109.3476 (240)   |
| Space heating - secondary     | 0.0000        | 0.0000           | 0.0000 (242)     |
| Water heating (other fuel)    | 2236.1102     | 3.4800           | 77.8166 (247)    |
| Pumps and fans for heating    | 30.0000       | 13.1900          | 3.9570 (249)     |
| Energy for lighting           | 334.3836      | 13.1900          | 44.1052 (250)    |
| Additional standing charges   |               |                  | 120.0000 (251)   |
| Total energy cost             |               |                  | 355.2265 (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] = 1.2260 (257)  
SAP value 82.8969  
SAP rating (Section 12) 83 (258)  
SAP band B

#### 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 | 3142.1731       | 0.2160                     | 678.7094 (261)        |
| Space heating - secondary     | 0.0000          | 0.0000                     | 0.0000 (263)          |
| Water heating (other fuel)    | 2236.1102       | 0.2160                     | 482.9998 (264)        |
| Space and water heating       |                 |                            | 1161.7092 (265)       |
| Pumps and fans                | 30.0000         | 0.5190                     | 15.5700 (267)         |
| Energy for lighting           | 334.3836        | 0.5190                     | 173.5451 (268)        |
| Total kg/year                 |                 |                            | 1350.8243 (272)       |
| CO2 emissions per m2          |                 |                            | 17.6100 (273)         |
| EI value                      |                 |                            | 85.1253               |
| EI rating                     |                 |                            | 85 (274)              |
| EI band                       |                 |                            | B                     |

#### Calculation of stars for heating and DHW

Main heating energy efficiency  $3.48 \times (1 + 0.29 \times 0.25) / 0.9330 = 4.000$ , stars = 4  
Main heating environmental impact  $0.216 \times (1 + 0.29 \times 0.25) / 0.9330 = 0.2483$ , stars = 4  
Water heating energy efficiency  $3.48 / 0.8672 = 4.013$ , stars = 5

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water heating environmental impact

$0.216 / 0.8672 = 0.2491$ , stars = 5

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## 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> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Basement floor                                         | 41.1400 (1a)              | x 2.4600 (2a)                   | = 101.2044 (1a) - (3a)      |
| Ground floor                                           | 35.5500 (1b)              | x 2.7600 (2b)                   | = 98.1180 (1b) - (3b)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 76.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 199.3224 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 30.0000 / (5) = 0.1505 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 4.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3505 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.2979 (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 |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3128 | 0.2979 | 0.2979 | 0.2756 | 0.2756 | 0.2458 | 0.2532 | 0.2383 | 0.2458 | 0.2607 | 0.2607 | 0.2830 (22b) |
|                 | 0.5489 | 0.5444 | 0.5444 | 0.5380 | 0.5380 | 0.5302 | 0.5321 | 0.5284 | 0.5302 | 0.5340 | 0.5340 | 0.5401 (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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| G (Uw = 1.40)                                                  |                         |                            | 18.9400                   | 1.3258                        | 25.1098      |                                      | (27)            |
| D                                                              |                         |                            | 2.0700                    | 1.4000                        | 2.8980       |                                      | (26)            |
| RL (Uw = 1.40)                                                 |                         |                            | 14.0500                   | 1.3258                        | 18.6269      |                                      | (27a)           |
| BF                                                             |                         |                            | 39.6400                   | 0.1800                        | 7.1352       | 110.0000                             | 4360.4000 (28)  |
| EF                                                             |                         |                            | 1.5000                    | 0.1800                        | 0.2700       | 110.0000                             | 165.0000 (28a)  |
| EW                                                             | 157.4000                | 21.0100                    | 136.3900                  | 0.2000                        | 27.2780      | 60.0000                              | 8183.4000 (29a) |
| FR                                                             | 42.6400                 | 14.0500                    | 28.5900                   | 0.1500                        | 4.2885       | 9.0000                               | 257.3100 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 241.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 85.6064      |                                      | (33)            |
| Internal Wall 1                                                |                         |                            | 115.0500                  |                               |              | 9.0000                               | 1035.4500 (32c) |
| Internal Floor 1                                               |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 15227.3600 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 198.5573 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 10.1659 (36)    |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 95.7724 (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                     | 36.1067  | 35.8075  | 35.8075  | 35.3860  | 35.3860  | 34.8751  | 34.9974  | 34.7565  | 34.8751  | 35.1233  | 35.1233  | 35.5229 (38)  |
| Heat transfer coeff       | 131.8791 | 131.5799 | 131.5799 | 131.1584 | 131.1584 | 130.6475 | 130.7698 | 130.5289 | 130.6475 | 130.8957 | 130.8957 | 131.2952 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 131.0863 (39) |
| HLP                       | 1.7196   | 1.7157   | 1.7157   | 1.7102   | 1.7102   | 1.7036   | 1.7052   | 1.7020   | 1.7036   | 1.7068   | 1.7068   | 1.7120 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.7093 (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                        |          |          |          |          |          |         |         |          |          |                    |          | 2.3971 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 91.1301 (43)   |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 100.2431 | 96.5979  | 92.9527  | 89.3075  | 85.6623  | 82.0171 | 82.0171 | 85.6623  | 89.3075  | 92.9527            | 96.5979  | 100.2431 (44)  |
| Energy conte                             | 148.6576 | 130.0169 | 134.1658 | 116.9690 | 112.2346 | 96.8499 | 89.7457 | 102.9845 | 104.2144 | 121.4519           | 132.5742 | 143.9670 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1433.8314 (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                          | 22.2986  | 19.5025  | 20.1249  | 17.5454  | 16.8352  | 14.5275  | 13.4618  | 15.4477  | 15.6322  | 18.2178  | 19.8861  | 21.5950 (46)     |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                  |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 170.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 1.2000 (48)      |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)      |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.6480 (55)      |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                  |
| 20.0880                                                         | 18.1440  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880 (56)     |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                  |
| 20.0880                                                         | 18.1440  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880  | 19.4400  | 20.0880  | 19.4400  | 20.0880  | 20.0880 (57)     |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)     |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                  |
| 192.0080                                                        | 169.1721 | 177.5162 | 158.9210 | 155.5850 | 138.8019 | 133.0961 | 146.3349 | 146.1664 | 164.8023 | 174.5262 | 187.3174 | 187.3174 (62)    |
| WWHRS                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 eq. (G10) |
| Total of WWHRS savings                                          |          |          |          |          |          |          |          |          |          |          |          | 0.0000           |
| 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                                                 |          |          |          |          |          |          |          |          |          |          |          |                  |
| 192.0080                                                        | 169.1721 | 177.5162 | 158.9210 | 155.5850 | 138.8019 | 133.0961 | 146.3349 | 146.1664 | 164.8023 | 174.5262 | 187.3174 | 187.3174 (64)    |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                  |
| 84.1090                                                         | 74.5548  | 79.2905  | 72.4538  | 71.9983  | 65.7642  | 64.5208  | 68.9227  | 68.2129  | 75.0631  | 77.6425  | 82.5493  | 82.5493 (65)     |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 47.3355  | 42.0429  | 34.1916  | 25.8853  | 19.3495  | 16.3357  | 17.6513  | 22.9438  | 30.7951  | 39.1015  | 45.6372  | 48.6511  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 316.9910 | 320.2804 | 311.9912 | 294.3447 | 272.0691 | 251.1332 | 237.1467 | 233.8573 | 242.1464 | 259.7930 | 282.0686 | 303.0045 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | (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)                                 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | (71) |
| Water heating gains (Table 5)                                                       | 113.0497 | 110.9446 | 106.5732 | 100.6303 | 96.7719  | 91.3391  | 86.7214  | 92.6380  | 94.7401  | 100.8912 | 107.8368 | 110.9534 | (72) |
| Total internal gains                                                                | 580.0967 | 575.9885 | 555.4766 | 523.5808 | 490.9111 | 461.5285 | 444.2399 | 452.1596 | 470.4022 | 502.5062 | 538.2632 | 565.3295 | (73) |

#### 6. Solar gains

| [Jan]       |          |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |           | Gains<br>W    |      |
|-------------|----------|-----------|-----------|-----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|-----------|---------------|------|
| Northeast   |          |           |           |           | 1.1300     | 12.9236                        |           | 0.6300                            | 0.7000                             | 0.7700                       |           | 4.4631 (75)   |      |
| Southeast   |          |           |           |           | 14.0500    | 40.4699                        |           | 0.6300                            | 0.7000                             | 0.7700                       |           | 173.7723 (77) |      |
| Southwest   |          |           |           |           | 3.7600     | 40.4699                        |           | 0.6300                            | 0.7000                             | 0.7700                       |           | 46.5042 (79)  |      |
| Northeast   |          |           |           |           | 14.0500    | 30.0000                        |           | 0.6300                            | 0.7000                             | 1.0000                       |           | 167.2934 (82) |      |
| -----       |          |           |           |           |            |                                |           |                                   |                                    |                              |           |               |      |
| Solar gains | 392.0328 | 658.0360  | 1018.1107 | 1486.6493 | 1763.0511  | 1932.1514                      | 1818.8873 | 1601.5690                         | 1264.7595                          | 816.2422                     | 493.4959  | 324.1716      | (83) |
| Total gains | 972.1295 | 1234.0244 | 1573.5873 | 2010.2301 | 2253.9622  | 2393.6799                      | 2263.1272 | 2053.7286                         | 1735.1618                          | 1318.7484                    | 1031.7591 | 889.5012      | (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                                                                         | 32.0735 | 32.1464 | 32.1464 | 32.2497 | 32.2497 | 32.3758 | 32.3456 | 32.4052 | 32.3758                   | 32.3145 | 32.3145 | 32.2161      |
| alpha                                                                       | 3.1382  | 3.1431  | 3.1431  | 3.1500  | 3.1500  | 3.1584  | 3.1564  | 3.1603  | 3.1584                    | 3.1543  | 3.1543  | 3.1477       |
| util living area                                                            | 0.9499  | 0.9056  | 0.8050  | 0.6263  | 0.4422  | 0.2696  | 0.1785  | 0.2023  | 0.4181                    | 0.7323  | 0.9071  | 0.9597 (86)  |
| MIT                                                                         | 19.7689 | 20.0268 | 20.4037 | 20.7220 | 20.8630 | 20.9070 | 20.9132 | 20.9127 | 20.8832                   | 20.6557 | 20.1655 | 19.7084 (87) |
| Th 2                                                                        | 19.5268 | 19.5296 | 19.5296 | 19.5335 | 19.5335 | 19.5383 | 19.5371 | 19.5394 | 19.5383                   | 19.5360 | 19.5360 | 19.5322 (88) |
| util rest of house                                                          | 0.9366  | 0.8831  | 0.7640  | 0.5653  | 0.3688  | 0.1923  | 0.0945  | 0.1105  | 0.3202                    | 0.6624  | 0.8801  | 0.9487 (89)  |
| MIT 2                                                                       | 17.9830 | 18.3410 | 18.8407 | 19.2261 | 19.3715 | 19.4104 | 19.4120 | 19.4143 | 19.3972                   | 19.1742 | 18.5483 | 17.9023 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1623 (91)  |
| MIT                                                                         | 18.2729 | 18.6147 | 19.0945 | 19.4689 | 19.6136 | 19.6534 | 19.6557 | 19.6575 | 19.6385                   | 19.4147 | 18.8108 | 18.1955 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |
| adjusted MIT                                                                | 18.1229 | 18.4647 | 18.9445 | 19.3189 | 19.4636 | 19.5034 | 19.5057 | 19.5075 | 19.4885                   | 19.2647 | 18.6608 | 18.0455 (93) |

#### 8. Space heating requirement

|                   |           |           |           |           |          |          |          |          |          |           |           |           |       |
|-------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|
| Utilisation       | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |       |
| Useful gains      | 893.9967  | 1064.4000 | 1172.4523 | 1116.9348 | 823.0266 | 455.7126 | 209.8737 | 222.7048 | 549.5035 | 854.0307  | 886.6161  | 830.2348  | (94)  |
| 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  | 1717.4502 | 1692.7350 | 1519.0172 | 1235.3727 | 847.7567 | 457.7062 | 209.9786 | 222.8827 | 560.2795 | 1003.2769 | 1395.4551 | 1699.6864 | (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 | 612.6494  | 422.2411  | 257.8443  | 85.2753   | 18.3992  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 111.0392  | 366.3641  | 646.8720  | (98)  |

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Space heating  
Space heating per m2 (98) / (4) = 2520.6845 (98)  
32.8685 (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 %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 96.3000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2617.5332 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 612.6494 | 422.2411 | 257.8443 | 85.2753  | 18.3992  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 111.0392 | 366.3641 | 646.8720  | (98)            |
| Space heating efficiency (main heating system 1)                      | 96.3000  | 96.3000  | 96.3000  | 96.3000  | 96.3000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 96.3000  | 96.3000  | 96.3000   | (210)           |
| Space heating fuel (main heating system)                              | 636.1884 | 438.4643 | 267.7511 | 88.5517  | 19.1061  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 115.3055 | 380.4404 | 671.7258  | (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                                             | 192.0080 | 169.1721 | 177.5162 | 158.9210 | 155.5850 | 138.8019 | 133.0961 | 146.3349 | 146.1664 | 164.8023 | 174.5262 | 187.3174  | (64)            |
| Efficiency of water heater (217)m                                     | 90.5025  | 89.9663  | 88.6192  | 86.0460  | 83.6141  | 82.6000  | 82.6000  | 82.6000  | 82.6000  | 86.5978  | 89.5567  | 90.6628   | (216)           |
| Fuel for water heating, kWh/month                                     | 212.1578 | 188.0394 | 200.3135 | 184.6931 | 186.0751 | 168.0410 | 161.1332 | 177.1608 | 176.9569 | 190.3076 | 194.8779 | 206.6089  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2246.3652 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2617.5332 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 334.3836  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5228.2820 | (238)           |

#### 10a. Fuel costs - using BEDF prices (589)

|                               | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|-------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1 | 2617.5332        | 6.3300              | 165.6899 (240)      |
| Space heating - secondary     | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)    | 2246.3652        | 6.3300              | 142.1949 (247)      |
| Pumps and fans for heating    | 30.0000          | 26.0600             | 7.8180 (249)        |
| Energy for lighting           | 334.3836         | 26.0600             | 87.1404 (250)       |
| Additional standing charges   |                  |                     | 113.0000 (251)      |
| Total energy cost             |                  |                     | 515.8431 (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 | 2617.5332          | 0.2160                        | 565.3872 (261)           |
| Space heating - secondary     | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)    | 2246.3652          | 0.2160                        | 485.2149 (264)           |
| Space and water heating       |                    |                               | 1050.6020 (265)          |
| Pumps and fans                | 30.0000            | 0.5190                        | 15.5700 (267)            |
| Energy for lighting           | 334.3836           | 0.5190                        | 173.5451 (268)           |
| Total kg/year                 |                    |                               | 1239.7171 (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 | 2617.5332          | 1.2200                              | 3193.3905 (261)            |
| Space heating - secondary     | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)    | 2246.3652          | 1.2200                              | 2740.5655 (264)            |
| Space and water heating       |                    |                                     | 5933.9560 (265)            |
| Pumps and fans                | 30.0000            | 3.0700                              | 92.1000 (267)              |
| Energy for lighting           | 334.3836           | 3.0700                              | 1026.5577 (268)            |
| Primary energy kWh/year       |                    |                                     | 7052.6137 (272)            |
| Primary energy kWh/m2/year    |                    |                                     | 91.9626 (273)              |

#### SAP 2012 EPC IMPROVEMENTS

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

|                         |                           |                  |                   |
|-------------------------|---------------------------|------------------|-------------------|
| (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:   |                           |                  |                   |
| N                       | Solar water heating       | SAP change + 1.7 | Cost change -£ 63 |
| U                       | Solar photovoltaic panels | + 11.0           | -£ 475            |
|                         |                           |                  | CO2 change        |
|                         |                           |                  | -234 kg (18.9%)   |
|                         |                           |                  | -947 kg (94.2%)   |

|                           | Typical annual savings | Energy efficiency | Environmental impact |
|---------------------------|------------------------|-------------------|----------------------|
| Recommended measures      |                        |                   |                      |
| Solar water heating       | £63                    | 3.05 kg/m²        | B 85                 |
| Solar photovoltaic panels | £475                   | 12.35 kg/m²       | A 96                 |
| Total Savings             | £539                   | 15.40 kg/m²       | A 98                 |

Potential energy efficiency rating: A 96  
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 589 TEST (12 Dec 2025)  
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                                                                | £95        | £108       | -£13       |
| Mains gas                                                                  | £421       | £345       | £76        |
| Space heating                                                              | £287       | £288       | -£1        |
| Water heating                                                              | £142       | £78        | £64        |
| Lighting                                                                   | £87        | £87        | £0         |
| Generated (PV)                                                             | -£0        | -£475      | £475       |
| Total cost of fuels                                                        | £516       | -£22       | £538       |
| Total cost of uses                                                         | £516       | -£22       | £538       |
| Delivered energy                                                           | 68 kWh/m²  | 29 kWh/m²  | 39 kWh/m²  |
| Carbon dioxide emissions                                                   | 1.2 tonnes | 0.1 tonnes | 1.2 tonnes |
| CO2 emissions per m²                                                       | 16 kg/m²   | 1 kg/m²    | 15 kg/m²   |
| Primary energy                                                             | 92 kWh/m²  | 2 kWh/m²   | 90 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> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Basement floor                                         | 41.1400 (1a)              | x 2.4600 (2a)                   | = 101.2044 (1a) - (3a)      |
| Ground floor                                           | 35.5500 (1b)              | x 2.7600 (2b)                   | = 98.1180 (1b) - (3b)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 76.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 199.3224 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 30.0000 / (5) = 0.1505 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 4.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3505 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.2979 (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 | 0.3799 | 0.3724 | 0.3650 | 0.3277 | 0.3203 | 0.2830 | 0.2830 | 0.2756 | 0.2979 | 0.3203 | 0.3352 | 0.3501 (22b) |
| Effective ac    | 0.5721 | 0.5693 | 0.5666 | 0.5537 | 0.5513 | 0.5401 | 0.5401 | 0.5380 | 0.5444 | 0.5513 | 0.5562 | 0.5613 (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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| G (Uw = 1.40)                                                  |                         |                            | 18.9400                   | 1.3258                        | 25.1098      |                                      | (27)            |
| D                                                              |                         |                            | 2.0700                    | 1.4000                        | 2.8980       |                                      | (26)            |
| RL (Uw = 1.40)                                                 |                         |                            | 14.0500                   | 1.3258                        | 18.6269      |                                      | (27a)           |
| BF                                                             |                         |                            | 39.6400                   | 0.1800                        | 7.1352       | 110.0000                             | 4360.4000 (28)  |
| EF                                                             |                         |                            | 1.5000                    | 0.1800                        | 0.2700       | 110.0000                             | 165.0000 (28a)  |
| EW                                                             | 157.4000                | 21.0100                    | 136.3900                  | 0.2000                        | 27.2780      | 60.0000                              | 8183.4000 (29a) |
| FR                                                             | 42.6400                 | 14.0500                    | 28.5900                   | 0.1500                        | 4.2885       | 9.0000                               | 257.3100 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 241.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 85.6064      |                                      | (33)            |
| Internal Wall 1                                                |                         |                            | 115.0500                  |                               |              | 9.0000                               | 1035.4500 (32c) |
| Internal Floor 1                                               |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 15227.3600 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 198.5573 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 10.1659 (36)    |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 95.7724 (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                     | 37.6339  | 37.4496  | 37.2690  | 36.4205  | 36.2618  | 35.5229  | 35.5229  | 35.3860  | 35.8075  | 36.2618  | 36.5829  | 36.9187 (38)  |
| Heat transfer coeff       | 133.4063 | 133.2220 | 133.0413 | 132.1929 | 132.0342 | 131.2952 | 131.2952 | 131.1584 | 131.5799 | 132.0342 | 132.3553 | 132.6910 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 132.1922 (39) |
| HLP                       | 1.7396   | 1.7371   | 1.7348   | 1.7237   | 1.7217   | 1.7120   | 1.7120   | 1.7102   | 1.7157   | 1.7217   | 1.7258   | 1.7302 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.7237 (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                        |          |          |          |          |          |         |         |          |          |                    |          | 2.3971 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 91.1301 (43)   |
| Jan                                      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug     | Sep      | Oct      | Nov                | Dec      |                |
| Daily hot water use                      | 100.2431 | 96.5979  | 92.9527  | 89.3075  | 85.6623  | 82.0171 | 82.0171 | 85.6623  | 89.3075  | 92.9527            | 96.5979  | 100.2431 (44)  |
| Energy conte                             | 148.6576 | 130.0169 | 134.1658 | 116.9690 | 112.2346 | 96.8499 | 89.7457 | 102.9845 | 104.2144 | 121.4519           | 132.5742 | 143.9670 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1433.8314 (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                                                                                           | 22.2986 | 19.5025 | 20.1249 | 17.5454 | 16.8352 | 14.5275 | 13.4618 | 15.4477 | 15.6322 | 18.2178 | 19.8861 | 21.5950 (46)    |
| Water storage loss:                                                                                                              |         |         |         |         |         |         |         |         |         |         |         |                 |
| Store volume                                                                                                                     |         |         |         |         |         |         |         |         |         |         |         | 190.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):                                                                      |         |         |         |         |         |         |         |         |         |         |         | 1.2924 (48)     |
| Temperature factor from Table 2b                                                                                                 |         |         |         |         |         |         |         |         |         |         |         | 0.5400 (49)     |
| Enter (49) or (54) in (55)                                                                                                       |         |         |         |         |         |         |         |         |         |         |         | 0.6979 (55)     |
| Total storage loss                                                                                                               |         |         |         |         |         |         |         |         |         |         |         |                 |
| 21.6341 19.5405 21.6341 20.9363 21.6341 20.9363 21.6341 21.6341 20.9363 21.6341 20.9363 21.6341 (56)                             |         |         |         |         |         |         |         |         |         |         |         |                 |
| If cylinder contains dedicated solar storage                                                                                     |         |         |         |         |         |         |         |         |         |         |         |                 |
| 13.0944 11.8272 13.0944 12.6720 13.0944 12.6720 13.0944 12.6720 13.0944 12.6720 13.0944 (57)                                     |         |         |         |         |         |         |         |         |         |         |         |                 |
| Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)                 |         |         |         |         |         |         |         |         |         |         |         |                 |
| Total heat required for water heating calculated for each month                                                                  |         |         |         |         |         |         |         |         |         |         |         |                 |
| 185.0144 162.8553 169.1268 145.3994 135.7970 119.4271 113.0755 127.2448 133.9955 156.4129 167.7582 180.3237 (62)                 |         |         |         |         |         |         |         |         |         |         |         |                 |
| WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 eq. (G10)                              |         |         |         |         |         |         |         |         |         |         |         |                 |
| Total of WWHRS savings                                                                                                           |         |         |         |         |         |         |         |         |         |         |         |                 |
| 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                                                                                                              |         |         |         |         |         |         |         |         |         |         |         | 1.2649 (H8)     |
| Utilisation factor                                                                                                               |         |         |         |         |         |         |         |         |         |         |         | 0.5464 (H9)     |
| Collector performance factor                                                                                                     |         |         |         |         |         |         |         |         |         |         |         | 0.8793 (H10)    |
| Dedicated solar storage volume                                                                                                   |         |         |         |         |         |         |         |         |         |         |         | 75.0000 (H11)   |
| Effective solar volume                                                                                                           |         |         |         |         |         |         |         |         |         |         |         | 109.5000 (H13)  |
| Daily hot water demand                                                                                                           |         |         |         |         |         |         |         |         |         |         |         | 91.1301 (H14)   |
| Volume ratio Veff/V                                                                                                              |         |         |         |         |         |         |         |         |         |         |         | 1.2016 (H15)    |
| Solar storage volume factor                                                                                                      |         |         |         |         |         |         |         |         |         |         |         | 1.0000 (H16)    |
| Solar input                                                                                                                      |         |         |         |         |         |         |         |         |         |         |         | -871.3804 (H17) |
| Solar input -25.2683 -42.1655 -71.8127 -96.2432 -118.9003 -116.8980 -115.3531 -100.7846 -78.9346 -53.9030 -29.9718 -21.1452 (63) |         |         |         |         |         |         |         |         |         |         |         |                 |
| Solar input (sum of months) = Sum (63)m =                                                                                        |         |         |         |         |         |         |         |         |         |         |         | -871.3804 (63)  |
| Output from w/h                                                                                                                  |         |         |         |         |         |         |         |         |         |         |         |                 |
| 159.7461 120.6898 97.3141 49.1562 16.8966 2.5291 0.0000 26.4602 55.0609 102.5099 137.7863 159.1785 (64)                          |         |         |         |         |         |         |         |         |         |         |         |                 |
| Total per year (kWh/year) = Sum (64)m =                                                                                          |         |         |         |         |         |         |         |         |         |         |         | 927.3277 (64)   |
| Heat gains from water heating, kWh/month                                                                                         |         |         |         |         |         |         |         |         |         |         |         |                 |
| 78.5141 69.5013 72.5789 61.6365 56.1679 50.2644 48.5043 53.6506 58.4762 68.3515 72.2281 76.9544 (65)                             |         |         |         |         |         |         |         |         |         |         |         |                 |

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

| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| (66)m                                                                               | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | 143.8234 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 47.3355  | 42.0429  | 34.1916  | 25.8853  | 19.3495  | 16.3357  | 17.6513  | 22.9438  | 30.7951  | 39.1015  | 45.6372  | 48.6511  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 316.9910 | 320.2804 | 311.9912 | 294.3447 | 272.0691 | 251.1332 | 237.1467 | 233.8573 | 242.1464 | 259.7930 | 282.0686 | 303.0045 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | 51.7794  | (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)                                 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | -95.8823 | (71) |
| Water heating gains (Table 5)                                                       | 105.5297 | 103.4246 | 97.5523  | 85.6062  | 75.4945  | 69.8116  | 65.1939  | 72.1110  | 81.2169  | 91.8704  | 100.3168 | 103.4334 | (72) |
| Total internal gains                                                                | 572.5766 | 568.4684 | 546.4557 | 508.5567 | 469.6337 | 440.0010 | 422.7124 | 431.6326 | 456.8790 | 493.4854 | 530.7431 | 557.8095 | (73) |

#### 6. Solar gains

| [Jan]       |          |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |           |           | Access<br>factor<br>Table 6d |               |  | Gains<br>W    |
|-------------|----------|-----------|-----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|-----------|-----------|------------------------------|---------------|--|---------------|
| Northeast   |          |           |           |           | 1.1300     | 11.2829                        | 0.6300                            | 0.7000                             |           |           | 0.7700                       |               |  | 3.8965 (75)   |
| Southeast   |          |           |           |           | 14.0500    | 36.7938                        | 0.6300                            | 0.7000                             |           |           | 0.7700                       |               |  | 157.9877 (77) |
| Southwest   |          |           |           |           | 3.7600     | 36.7938                        | 0.6300                            | 0.7000                             |           |           | 0.7700                       |               |  | 42.2800 (79)  |
| Northeast   |          |           |           |           | 14.0500    | 26.0000                        | 0.6300                            | 0.7000                             |           |           | 1.0000                       |               |  | 144.9876 (82) |
| -----       |          |           |           |           |            |                                |                                   |                                    |           |           |                              |               |  |               |
| Solar gains | 349.1517 | 650.1893  | 1016.3774 | 1438.2592 | 1749.9946  | 1792.0072                      | 1705.4139                         | 1468.7770                          | 1164.0938 | 754.7594  | 428.7999                     | 291.6748 (83) |  |               |
| Total gains | 921.7283 | 1218.6577 | 1562.8331 | 1946.8159 | 2219.6283  | 2232.0082                      | 2128.1263                         | 1900.4097                          | 1620.9728 | 1248.2447 | 959.5431                     | 849.4842 (84) |  |               |

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

|                                                                                          |         |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C)              |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)                       |         |         |         |         |         |         |         |         |         |         |         |         |              |
| tau                                                                                      | 31.7063 | 31.7502 | 31.7933 | 31.9973 | 32.0358 | 32.2161 | 32.2161 | 32.2497 | 32.1464 | 32.0358 | 31.9581 | 31.8772 |              |
| alpha                                                                                    | 3.1138  | 3.1167  | 3.1196  | 3.1332  | 3.1357  | 3.1477  | 3.1477  | 3.1500  | 3.1431  | 3.1357  | 3.1305  | 3.1251  |              |
| util living area                                                                         | 0.9614  | 0.9178  | 0.8303  | 0.6792  | 0.5109  | 0.3654  | 0.2682  | 0.3116  | 0.5163  | 0.7931  | 0.9331  | 0.9691  | (86)         |
| MIT                                                                                      | 19.6091 | 19.9153 | 20.2991 | 20.6437 | 20.8226 | 20.8904 | 20.9076 | 20.9036 | 20.8450 | 20.5403 | 19.9934 | 19.5444 | (87)         |
| Th 2                                                                                     | 19.5126 | 19.5143 | 19.5160 | 19.5239 | 19.5253 | 19.5322 | 19.5322 | 19.5335 | 19.5296 | 19.5253 | 19.5224 | 19.5192 | (88)         |
| util rest of house                                                                       |         |         |         |         |         |         |         |         |         |         |         |         |              |
| 0.9514 0.8984 0.7946 0.6239 0.4419 0.2859 0.1802 0.2149 0.4213 0.7360 0.9135 0.9608 (89) |         |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT 2                                                                                    | 17.7448 | 18.1738 | 18.6914 | 19.1268 | 19.3247 | 19.3935 | 19.4048 | 19.4046 | 19.3591 | 19.0284 | 18.3004 | 17.6577 | (90)         |
| Living area fraction                                                                     |         |         |         |         |         |         |         |         |         |         |         |         | 0.1623 (91)  |
| fLA = Living area / (4) =                                                                |         |         |         |         |         |         |         |         |         |         |         |         |              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

|                        |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| MIT                    | 18.0474 | 18.4565 | 18.9524 | 19.3731 | 19.5678 | 19.6365 | 19.6488 | 19.6479 | 19.6003 | 19.2738 | 18.5753 | 17.9640 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |         |         |         | -0.1500      |
| adjusted MIT           | 17.8974 | 18.3065 | 18.8024 | 19.2231 | 19.4178 | 19.4865 | 19.4988 | 19.4979 | 19.4503 | 19.1238 | 18.4253 | 17.8140 (93) |

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec            |              |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|----------------|--------------|
| Utilisation          | 0.9363    | 0.8782    | 0.7745    | 0.6115    | 0.4366    | 0.2834   | 0.1782   | 0.2125   | 0.4159   | 0.7176    | 0.8942    | 0.9475 (94)    |              |
| Useful gains         | 863.0351  | 1070.2850 | 1210.3405 | 1190.4810 | 969.0335  | 632.4881 | 379.2126 | 403.8370 | 674.0926 | 895.7527  | 858.0028  | 804.9216 (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     | 1813.9836 | 1786.0470 | 1636.7296 | 1364.6351 | 1019.0181 | 641.5702 | 380.6000 | 406.3184 | 703.9895 | 1125.4344 | 1498.9594 | 1806.4536 (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    | 707.5057  | 480.9921  | 317.2335  | 125.3909  | 37.1885   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 170.8832  | 461.4887  | 745.1398 (98)  |              |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           | 3045.8225 (98) |              |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           | 39.7160 (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 %)                      |          |          |          |          |         |         |         |         |            |          |          |                  | 96.3000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |         |         |         |         |            |          |          |                  | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |         |         |         |         |            |          |          |                  | 3162.8478 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep        | Oct      | Nov      | Dec              |                 |
| Space heating requirement                                             | 707.5057 | 480.9921 | 317.2335 | 125.3909 | 37.1885 | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 170.8832 | 461.4887 | 745.1398 (98)    |                 |
| Space heating efficiency (main heating system 1)                      | 96.3000  | 96.3000  | 96.3000  | 96.3000  | 96.3000 | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 96.3000  | 96.3000  | 96.3000 (210)    |                 |
| Space heating fuel (main heating system)                              | 734.6892 | 499.4726 | 329.4221 | 130.2086 | 38.6174 | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 177.4488 | 479.2199 | 773.7693 (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                                             | 159.7461 | 120.6898 | 97.3141  | 49.1562  | 16.8966 | 2.5291  | 0.0000  | 26.4602 | 55.0609    | 102.5099 | 137.7863 | 159.1785 (64)    |                 |
| Efficiency of water heater (217)m                                     | 91.1257  | 90.9371  | 90.5466  | 90.0161  | 89.6711 | 82.6000 | 82.6000 | 82.6000 | 82.6000    | 88.9782  | 90.6015  | 91.2200 (217)    |                 |
| Fuel for water heating, kWh/month                                     | 175.3031 | 132.7179 | 107.4741 | 54.6082  | 18.8429 | 3.0619  | 0.0000  | 32.0341 | 66.6597    | 115.2078 | 152.0795 | 174.4995 (219)   |                 |
| Water heating fuel used                                               |          |          |          |          |         |         |         |         |            |          |          | 1032.4888 (219)  |                 |
| Annual totals kWh/year                                                |          |          |          |          |         |         |         |         |            |          |          |                  |                 |
| Space heating fuel - main system                                      |          |          |          |          |         |         |         |         |            |          |          | 3162.8478 (211)  |                 |
| Space heating fuel - secondary                                        |          |          |          |          |         |         |         |         |            |          |          | 0.0000 (215)     |                 |
| Electricity for pumps and fans:                                       |          |          |          |          |         |         |         |         |            |          |          |                  |                 |
| central heating pump                                                  |          |          |          |          |         |         |         |         |            |          |          | 30.0000 (230c)   |                 |
| pump for solar water heating                                          |          |          |          |          |         |         |         |         |            |          |          | 50.0000 (230g)   |                 |
| Total electricity for the above, kWh/year                             |          |          |          |          |         |         |         |         |            |          |          | 80.0000 (231)    |                 |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |         |         |         |         |            |          |          | 334.3836 (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                                   |          |          |          |          |         |         |         |         |            |          |          | 2882.4808 (238)  |                 |

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

|                                       | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |  |
|---------------------------------------|---------------|------------------|------------------|--|
| Space heating - main system 1         | 3162.8478     | 3.4800           | 110.0671 (240)   |  |
| Space heating - secondary             | 0.0000        | 0.0000           | 0.0000 (242)     |  |
| Water heating (other fuel)            | 1032.4888     | 3.4800           | 35.9306 (247)    |  |
| Pumps and fans for heating            | 30.0000       | 13.1900          | 3.9570 (249)     |  |
| Pump for solar water heating          | 50.0000       | 13.1900          | 6.5950 (249)     |  |
| Energy for lighting                   | 334.3836      | 13.1900          | 44.1052 (250)    |  |
| Additional standing charges           |               |                  | 120.0000 (251)   |  |
| Energy saving/generation technologies |               |                  |                  |  |
| PV Unit                               | -1727.2394    | 13.1900          | -227.8229 (252)  |  |
| Total energy cost                     |               |                  | 92.8320 (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] = | 0.3204 (257) |
| SAP value                        |                                  | 95.5304      |
| SAP rating (Section 12)          |                                  | 96 (258)     |
| SAP band                         |                                  | A            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

### 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         | 3162.8478          | 0.2160                        | 683.1751                 | (261) |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000                   | (263) |
| Water heating (other fuel)            | 1032.4888          | 0.2160                        | 223.0176                 | (264) |
| Space and water heating               |                    |                               | 906.1927                 | (265) |
| Pumps and fans                        | 80.0000            | 0.5190                        | 41.5200                  | (267) |
| Energy for lighting                   | 334.3836           | 0.5190                        | 173.5451                 | (268) |
| Energy saving/generation technologies |                    |                               |                          |       |
| PV Unit                               | -1727.2394         | 0.5190                        | -896.4372                | (269) |
| Total kg/year                         |                    |                               | 224.8206                 | (272) |
| CO2 emissions per m2                  |                    |                               | 2.9300                   | (273) |
| EI value                              |                    |                               | 97.5244                  |       |
| EI rating                             |                    |                               | 98                       | (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> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Basement floor                                         | 41.1400 (1a)              | x 2.4600 (2a)                   | = 101.2044 (1a) - (3a)      |
| Ground floor                                           | 35.5500 (1b)              | x 2.7600 (2b)                   | = 98.1180 (1b) - (3b)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 76.6900                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 199.3224 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 30.0000 / (5) = 0.1505 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 4.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3505 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.2979 (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 |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3128 | 0.2979 | 0.2979 | 0.2756 | 0.2756 | 0.2458 | 0.2532 | 0.2383 | 0.2458 | 0.2607 | 0.2607 | 0.2830 (22b) |
|                 | 0.5489 | 0.5444 | 0.5444 | 0.5380 | 0.5380 | 0.5302 | 0.5321 | 0.5284 | 0.5302 | 0.5340 | 0.5340 | 0.5401 (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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| G (Uw = 1.40)                                                  |                         |                            | 18.9400                   | 1.3258                        | 25.1098      |                                      | (27)            |
| D                                                              |                         |                            | 2.0700                    | 1.4000                        | 2.8980       |                                      | (26)            |
| RL (Uw = 1.40)                                                 |                         |                            | 14.0500                   | 1.3258                        | 18.6269      |                                      | (27a)           |
| BF                                                             |                         |                            | 39.6400                   | 0.1800                        | 7.1352       | 110.0000                             | 4360.4000 (28)  |
| EF                                                             |                         |                            | 1.5000                    | 0.1800                        | 0.2700       | 110.0000                             | 165.0000 (28a)  |
| EW                                                             | 157.4000                | 21.0100                    | 136.3900                  | 0.2000                        | 27.2780      | 60.0000                              | 8183.4000 (29a) |
| FR                                                             | 42.6400                 | 14.0500                    | 28.5900                   | 0.1500                        | 4.2885       | 9.0000                               | 257.3100 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 241.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 85.6064      |                                      | (33)            |
| Internal Wall 1                                                |                         |                            | 115.0500                  |                               |              | 9.0000                               | 1035.4500 (32c) |
| Internal Floor 1                                               |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 34.0500                   |                               |              | 18.0000                              | 612.9000 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 15227.3600 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 198.5573 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 10.1659 (36)    |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 95.7724 (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                     | 36.1067  | 35.8075  | 35.8075  | 35.3860  | 35.3860  | 34.8751  | 34.9974  | 34.7565  | 34.8751  | 35.1233  | 35.1233  | 35.5229 (38)  |
| Heat transfer coeff       | 131.8791 | 131.5799 | 131.5799 | 131.1584 | 131.1584 | 130.6475 | 130.7698 | 130.5289 | 130.6475 | 130.8957 | 130.8957 | 131.2952 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 131.0863 (39) |
| HLP                       | 1.7196   | 1.7157   | 1.7157   | 1.7102   | 1.7102   | 1.7036   | 1.7052   | 1.7020   | 1.7036   | 1.7068   | 1.7068   | 1.7120 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.7093 (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                        |          |          |          |          |          |         |         |          |          |                    |          | 2.3971 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |          |          |                    |          | 91.1301 (43)   |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                      | 100.2431 | 96.5979  | 92.9527  | 89.3075  | 85.6623  | 82.0171 | 82.0171 | 85.6623  | 89.3075  | 92.9527            | 96.5979  | 100.2431 (44)  |
| Energy conte                             | 148.6576 | 130.0169 | 134.1658 | 116.9690 | 112.2346 | 96.8499 | 89.7457 | 102.9845 | 104.2144 | 121.4519           | 132.5742 | 143.9670 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1433.8314 (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                                                                                           | 22.2986 | 19.5025 | 20.1249 | 17.5454 | 16.8352 | 14.5275 | 13.4618 | 15.4477 | 15.6322 | 18.2178 | 19.8861 | 21.5950 (46)    |
| Water storage loss:                                                                                                              |         |         |         |         |         |         |         |         |         |         |         |                 |
| Store volume                                                                                                                     |         |         |         |         |         |         |         |         |         |         |         | 190.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):                                                                      |         |         |         |         |         |         |         |         |         |         |         | 1.2924 (48)     |
| Temperature factor from Table 2b                                                                                                 |         |         |         |         |         |         |         |         |         |         |         | 0.5400 (49)     |
| Enter (49) or (54) in (55)                                                                                                       |         |         |         |         |         |         |         |         |         |         |         | 0.6979 (55)     |
| Total storage loss                                                                                                               |         |         |         |         |         |         |         |         |         |         |         |                 |
| 21.6341 19.5405 21.6341 20.9363 21.6341 20.9363 21.6341 21.6341 20.9363 21.6341 20.9363 21.6341 (56)                             |         |         |         |         |         |         |         |         |         |         |         |                 |
| If cylinder contains dedicated solar storage                                                                                     |         |         |         |         |         |         |         |         |         |         |         |                 |
| 13.0944 11.8272 13.0944 12.6720 13.0944 12.6720 13.0944 12.6720 13.0944 12.6720 13.0944 (57)                                     |         |         |         |         |         |         |         |         |         |         |         |                 |
| Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)                 |         |         |         |         |         |         |         |         |         |         |         |                 |
| Total heat required for water heating calculated for each month                                                                  |         |         |         |         |         |         |         |         |         |         |         |                 |
| 185.0144 162.8553 169.1268 145.3994 135.7970 119.4271 113.0755 127.2448 133.9955 156.4129 167.7582 180.3237 (62)                 |         |         |         |         |         |         |         |         |         |         |         |                 |
| WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 eq. (G10)                              |         |         |         |         |         |         |         |         |         |         |         |                 |
| Total of WWHRS savings                                                                                                           |         |         |         |         |         |         |         |         |         |         |         |                 |
| 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                                                                                                              |         |         |         |         |         |         |         |         |         |         |         | 1.3358 (H8)     |
| Utilisation factor                                                                                                               |         |         |         |         |         |         |         |         |         |         |         | 0.5270 (H9)     |
| Collector performance factor                                                                                                     |         |         |         |         |         |         |         |         |         |         |         | 0.8793 (H10)    |
| Dedicated solar storage volume                                                                                                   |         |         |         |         |         |         |         |         |         |         |         | 75.0000 (H11)   |
| Effective solar volume                                                                                                           |         |         |         |         |         |         |         |         |         |         |         | 109.5000 (H13)  |
| Daily hot water demand                                                                                                           |         |         |         |         |         |         |         |         |         |         |         | 91.1301 (H14)   |
| Volume ratio Veff/V                                                                                                              |         |         |         |         |         |         |         |         |         |         |         | 1.2016 (H15)    |
| Solar storage volume factor                                                                                                      |         |         |         |         |         |         |         |         |         |         |         | 1.0000 (H16)    |
| Solar input                                                                                                                      |         |         |         |         |         |         |         |         |         |         |         | -887.5047 (H17) |
| Solar input -27.3169 -41.0573 -69.1457 -95.5806 -115.1111 -121.1495 -118.2404 -105.5894 -82.4129 -56.0640 -33.2045 -22.6323 (63) |         |         |         |         |         |         |         |         |         |         |         |                 |
| Solar input (sum of months) = Sum(63)m = -887.5047 (63)                                                                          |         |         |         |         |         |         |         |         |         |         |         |                 |
| Output from w/h                                                                                                                  |         |         |         |         |         |         |         |         |         |         |         |                 |
| 157.6975 121.7980 99.9811 49.8188 20.6859 0.0000 0.0000 21.6553 51.5826 100.3489 134.5537 157.6915 (64)                          |         |         |         |         |         |         |         |         |         |         |         |                 |
| Total per year (kWh/year) = Sum(64)m = 915.8131 (64)                                                                             |         |         |         |         |         |         |         |         |         |         |         |                 |
| Heat gains from water heating, kWh/month                                                                                         |         |         |         |         |         |         |         |         |         |         |         |                 |
| 78.5141 69.5013 72.5789 61.6365 56.1679 50.2644 48.5043 53.6506 58.4762 68.3515 72.2281 76.9544 (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 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 143.8234 (66) |     |     |     |     |     |     |     |     |     |     |     |     |      |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5                                                 |     |     |     |     |     |     |     |     |     |     |     |     |      |
| 47.3355 42.0429 34.1916 25.8853 19.3495 16.3357 17.6513 22.9438 30.7951 39.1015 45.6372 48.6511 (67)                            |     |     |     |     |     |     |     |     |     |     |     |     |      |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5                                             |     |     |     |     |     |     |     |     |     |     |     |     |      |
| 316.9910 320.2804 311.9912 294.3447 272.0691 251.1332 237.1467 233.8573 242.1464 259.7930 282.0686 303.0045 (68)                |     |     |     |     |     |     |     |     |     |     |     |     |      |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5                                                |     |     |     |     |     |     |     |     |     |     |     |     |      |
| 51.7794 51.7794 51.7794 51.7794 51.7794 51.7794 51.7794 51.7794 51.7794 51.7794 51.7794 51.7794 (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)                                                                             |     |     |     |     |     |     |     |     |     |     |     |     |      |
| -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 -95.8823 (71)                |     |     |     |     |     |     |     |     |     |     |     |     |      |
| Water heating gains (Table 5)                                                                                                   |     |     |     |     |     |     |     |     |     |     |     |     |      |
| 105.5297 103.4246 97.5523 85.6062 75.4945 69.8116 65.1939 72.1110 81.2169 91.8704 100.3168 103.4334 (72)                        |     |     |     |     |     |     |     |     |     |     |     |     |      |
| Total internal gains                                                                                                            |     |     |     |     |     |     |     |     |     |     |     |     |      |
| 572.5766 568.4684 546.4557 508.5567 469.6337 440.0010 422.7124 431.6326 456.8790 493.4854 530.7431 557.8095 (73)                |     |     |     |     |     |     |     |     |     |     |     |     |      |

#### 6. Solar gains

| [Jan]       |          |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |           | Gains<br>W    |
|-------------|----------|-----------|-----------|-----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|-----------|---------------|
| Northeast   |          |           |           |           | 1.1300     | 12.9236                        |           | 0.6300                            | 0.7000                             | 0.7700                       |           | 4.4631 (75)   |
| Southeast   |          |           |           |           | 14.0500    | 40.4699                        |           | 0.6300                            | 0.7000                             | 0.7700                       |           | 173.7723 (77) |
| Southwest   |          |           |           |           | 3.7600     | 40.4699                        |           | 0.6300                            | 0.7000                             | 0.7700                       |           | 46.5042 (79)  |
| Northeast   |          |           |           |           | 14.0500    | 30.0000                        |           | 0.6300                            | 0.7000                             | 1.0000                       |           | 167.2934 (82) |
| -----       |          |           |           |           |            |                                |           |                                   |                                    |                              |           |               |
| Solar gains | 392.0328 | 658.0360  | 1018.1107 | 1486.6493 | 1763.0511  | 1932.1514                      | 1818.8873 | 1601.5690                         | 1264.7595                          | 816.2422                     | 493.4959  | 324.1716 (83) |
| Total gains | 964.6095 | 1226.5044 | 1564.5665 | 1995.2060 | 2232.6848  | 2372.1524                      | 2241.5997 | 2033.2016                         | 1721.6385                          | 1309.7276                    | 1024.2390 | 881.9811 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |              | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |              |
| tau                                                                         | 32.0735 | 32.1464 | 32.1464 | 32.2497 | 32.2497 | 32.3758 | 32.3456 | 32.4052 | 32.3758 | 32.3145 | 32.3145 | 32.2161      |              |
| alpha                                                                       | 3.1382  | 3.1431  | 3.1431  | 3.1500  | 3.1500  | 3.1584  | 3.1564  | 3.1603  | 3.1584  | 3.1543  | 3.1543  | 3.1477       |              |
| util living area                                                            | 0.9508  | 0.9069  | 0.8069  | 0.6295  | 0.4458  | 0.2720  | 0.1802  | 0.2043  | 0.4211  | 0.7351  | 0.9086  | 0.9605 (86)  |              |
| MIT                                                                         | 19.7628 | 20.0216 | 20.3996 | 20.7191 | 20.8618 | 20.9068 | 20.9132 | 20.9126 | 20.8826 | 20.6527 | 20.1603 | 19.7021 (87) |              |
| Th 2                                                                        | 19.5268 | 19.5296 | 19.5296 | 19.5335 | 19.5335 | 19.5383 | 19.5371 | 19.5394 | 19.5383 | 19.5360 | 19.5360 | 19.5322 (88) |              |
| util rest of house                                                          | 0.9378  | 0.8845  | 0.7661  | 0.5685  | 0.3720  | 0.1940  | 0.0955  | 0.1116  | 0.3225  | 0.6654  | 0.8819  | 0.9497 (89)  |              |
| MIT 2                                                                       | 17.9745 | 18.3341 | 18.8357 | 19.2231 | 19.3705 | 19.4103 | 19.4120 | 19.4143 | 19.3969 | 19.1711 | 18.5414 | 17.8935 (90) |              |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              | 0.1623 (91)  |
| fLA = Living area / (4) =                                                   |         |         |         |         |         |         |         |         |         |         |         |              |              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

|                        |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| MIT                    | 18.2648 | 18.6081 | 19.0896 | 19.4660 | 19.6126 | 19.6533 | 19.6557 | 19.6575 | 19.6381 | 19.4116 | 18.8043 | 18.1871 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |         |         |         | -0.1500      |
| adjusted MIT           | 18.1148 | 18.4581 | 18.9396 | 19.3160 | 19.4626 | 19.5033 | 19.5057 | 19.5075 | 19.4881 | 19.2616 | 18.6543 | 18.0371 (93) |

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                       |  |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|---------------------------|--|
| Utilisation          | 0.9209    | 0.8641    | 0.7471    | 0.5587    | 0.3683   | 0.1921   | 0.0936   | 0.1095   | 0.3190   | 0.6504    | 0.8612    | 0.9346 (94)               |  |
| Useful gains         | 888.3291  | 1059.7798 | 1168.9626 | 1114.7083 | 822.2916 | 455.6466 | 209.8692 | 222.6971 | 549.2245 | 851.8106  | 882.0521  | 824.2912 (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     | 1716.3840 | 1691.8643 | 1518.3740 | 1234.9838 | 847.6294 | 457.6933 | 209.9772 | 222.8805 | 560.2284 | 1002.8747 | 1394.5960 | 1698.5755 (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    | 616.0729  | 424.7608  | 259.9621  | 86.5983   | 18.8513  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 112.3917  | 369.0316  | 650.4675 (98)             |  |
| Space heating        |           |           |           |           |          |          |          |          |          |           |           | 2538.1362 (98)            |  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |           |           | (98) / (4) = 33.0961 (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 %)                      |          |          |          |         |         |         |         |         |            |          |          |                  | 96.3000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |         |         |         |         |         |            |          |          |                  | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |         |         |         |         |         |            |          |          |                  | 2635.6555 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep        | Oct      | Nov      | Dec              |                 |
| Space heating requirement                                             | 616.0729 | 424.7608 | 259.9621 | 86.5983 | 18.8513 | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 112.3917 | 369.0316 | 650.4675 (98)    |                 |
| Space heating efficiency (main heating system 1)                      | 96.3000  | 96.3000  | 96.3000  | 96.3000 | 96.3000 | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 96.3000  | 96.3000  | 96.3000 (210)    |                 |
| Space heating fuel (main heating system)                              | 639.7434 | 441.0808 | 269.9503 | 89.9256 | 19.5756 | 0.0000  | 0.0000  | 0.0000  | 0.0000     | 116.7099 | 383.2104 | 675.4595 (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                                             | 157.6975 | 121.7980 | 99.9811  | 49.8188 | 20.6859 | 0.0000  | 0.0000  | 21.6553 | 51.5826    | 100.3489 | 134.5537 | 157.6915 (64)    |                 |
| Efficiency of water heater (217)m                                     | 90.9002  | 90.6822  | 90.0595  | 89.0856 | 87.3779 | 82.6000 | 82.6000 | 82.6000 | 82.6000    | 87.9273  | 90.1787  | 82.6000 (216)    |                 |
| Fuel for water heating, kWh/month                                     | 173.4842 | 134.3129 | 111.0168 | 55.9224 | 23.6740 | 0.0000  | 0.0000  | 26.2171 | 62.4486    | 114.1271 | 149.2078 | 173.2876 (219)   |                 |
| Water heating fuel used                                               |          |          |          |         |         |         |         |         |            |          |          | 1023.6985 (219)  |                 |
| Annual totals kWh/year                                                |          |          |          |         |         |         |         |         |            |          |          |                  |                 |
| Space heating fuel - main system                                      |          |          |          |         |         |         |         |         |            |          |          | 2635.6555 (211)  |                 |
| Space heating fuel - secondary                                        |          |          |          |         |         |         |         |         |            |          |          | 0.0000 (215)     |                 |
| Electricity for pumps and fans:                                       |          |          |          |         |         |         |         |         |            |          |          |                  |                 |
| central heating pump                                                  |          |          |          |         |         |         |         |         |            |          |          |                  | 30.0000 (230c)  |
| pump for solar water heating                                          |          |          |          |         |         |         |         |         |            |          |          |                  | 50.0000 (230g)  |
| Total electricity for the above, kWh/year                             |          |          |          |         |         |         |         |         |            |          |          |                  | 80.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |         |         |         |         |         |            |          |          |                  | 334.3836 (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                                   |          |          |          |         |         |         |         |         |            |          |          | 2249.5780 (238)  |                 |

#### 10a. Fuel costs - using BEDF prices (589)

|                                       | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |  |
|---------------------------------------|---------------|------------------|------------------|--|
| Space heating - main system 1         | 2635.6555     | 6.3300           | 166.8370 (240)   |  |
| Space heating - secondary             | 0.0000        | 0.0000           | 0.0000 (242)     |  |
| Water heating (other fuel)            | 1023.6985     | 6.3300           | 64.8001 (247)    |  |
| Pumps and fans for heating            | 30.0000       | 26.0600          | 7.8180 (249)     |  |
| Pump for solar water heating          | 50.0000       | 26.0600          | 13.0300 (249)    |  |
| Energy for lighting                   | 334.3836      | 26.0600          | 87.1404 (250)    |  |
| Additional standing charges           |               |                  | 113.0000 (251)   |  |
| Energy saving/generation technologies |               |                  |                  |  |
| PV Unit                               | -1824.1596    | 26.0600          | -475.3760 (252)  |  |
| Total energy cost                     |               |                  | -22.7505 (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 | 2635.6555       | 0.2160                     | 569.3016 (261)        |  |
| Space heating - secondary     | 0.0000          | 0.0000                     | 0.0000 (263)          |  |
| Water heating (other fuel)    | 1023.6985       | 0.2160                     | 221.1189 (264)        |  |
| Space and water heating       |                 |                            | 790.4205 (265)        |  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

|                                       |            |        |                 |
|---------------------------------------|------------|--------|-----------------|
| Pumps and fans                        | 80.0000    | 0.5190 | 41.5200 (267)   |
| Energy for lighting                   | 334.3836   | 0.5190 | 173.5451 (268)  |
| Energy saving/generation technologies |            |        |                 |
| PV Unit                               | -1824.1596 | 0.5190 | -946.7389 (269) |
| Total kg/year                         |            |        | 58.7467 (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         | 2635.6555          | 1.2200                              | 3215.4997 (261)            |
| Space heating - secondary             | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)            | 1023.6985          | 1.2200                              | 1248.9122 (264)            |
| Space and water heating               |                    |                                     | 4464.4119 (265)            |
| Pumps and fans                        | 80.0000            | 3.0700                              | 245.6000 (267)             |
| Energy for lighting                   | 334.3836           | 3.0700                              | 1026.5577 (268)            |
| Energy saving/generation technologies |                    |                                     |                            |
| PV Unit                               | -1824.1596         | 3.0700                              | -5600.1701 (269)           |
| Primary energy kWh/year               |                    |                                     | 136.3995 (272)             |
| Primary energy kWh/m2/year            |                    |                                     | 1.7786 (273)               |