

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

|                                    |                                                                                                     |               |       |                |            |
|------------------------------------|-----------------------------------------------------------------------------------------------------|---------------|-------|----------------|------------|
| Property Reference                 | 3604-1                                                                                              |               |       | Issued on Date | 16/12/2020 |
| Assessment Reference               | 36.4-1ds                                                                                            | Prop Type Ref |       |                |            |
| Property                           | 105, Addington Road, Reading, RG1 5PZ                                                               |               |       |                |            |
|                                    |                                                                                                     |               |       |                |            |
| SAP Rating                         | 91 B                                                                                                | DER           | 8.51  | TER            | 18.96      |
| Environmental                      | 92 A                                                                                                | % DER<TER     | 55.11 |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.15                                                                                                | DFEE          | 35.31 | TFEE           | 42.32      |
| General Requirements Compliance    | Pass                                                                                                | % DFEE<TFEE   | 16.55 |                |            |
|                                    |                                                                                                     |               |       |                |            |
| Assessor Details                   | Mr. Ian Lloyd, Property and Energy Services Limited, Tel: 01367240212, ianl@propertyandenergy.co.uk |               |       | Assessor ID    | H044-0001  |
| Client                             |                                                                                                     |               |       |                |            |

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

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

#### DWELLING AS DESIGNED

Mid-Terrace House, total floor area 165 m<sup>2</sup>

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

#### 1a TER and DER

Fuel for main heating: Electricity

Fuel factor: 1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 18.96 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 8.51 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 42.3 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE) 35.3 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.13 (max. 0.25) | 0.13 (max. 0.70) | OK |
| Roof          | 0.13 (max. 0.20) | 0.16 (max. 0.35) | OK |
| Openings      | 1.46 (max. 2.00) | 1.50 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 5.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Heat pump with radiators or underfloor - Electric  
Vaillant aroTHERM plus 7kW + hydraulic module VWL75/6A230VS2+VWZMEH97/5MB2

Secondary heating system: None

#### 5 Cylinder insulation

|                             |                                      |    |
|-----------------------------|--------------------------------------|----|
| Hot water storage           | Measured cylinder loss: 1.60 kWh/day |    |
| Permitted by DBSCG 2.56     | OK                                   |    |
| Primary pipework insulated: | Yes                                  | OK |

#### 6 Controls

|                         |                                   |    |
|-------------------------|-----------------------------------|----|
| Space heating controls: | Time and temperature zone control | OK |
| Hot water controls:     | Cylinderstat                      | OK |
|                         | Independent timer for DHW         | OK |

#### 7 Low energy lights

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

#### 8 Mechanical ventilation

Not applicable

#### 9 Summertime temperature

Overheating risk (Thames Valley): Not significant OK

Based on:

Overshading:

Windows facing North: 14.67 m<sup>2</sup>, No overhang

Windows facing South: 8.22 m<sup>2</sup>, No overhang

Air change rate: 4.00 ach

Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

#### 10 Key features

|                       |                         |
|-----------------------|-------------------------|
| External wall U-value | 0.12 W/m <sup>2</sup> K |
| Party wall U-value    | 0.00 W/m <sup>2</sup> K |
| Roof U-value          | 0.11 W/m <sup>2</sup> K |
| Door U-value          | 1.00 W/m <sup>2</sup> K |

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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m) | Volume<br>(m <sup>3</sup> )                            |
|--------------------------------------------------------|---------------------------|----------------------|--------------------------------------------------------|
| Basement floor                                         | 46.3700 (1a)              | x 2.3800 (2a)        | = 110.3606 (1a) - (3a)                                 |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)        | = 123.8079 (1b) - (3b)                                 |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)        | = 104.3546 (1c) - (3c)                                 |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)        | = 76.1436 (1d) - (3d)                                  |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                      | (3a) + (3b) + (3c) + (3d) + (3e)...(3n) = 414.6667 (5) |
| Dwelling volume                                        |                           |                      |                                                        |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3239 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3460 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

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

| Element                                                        | Gross<br>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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Door -1                                                        |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| W-1.5 (Uw = 1.50)                                              |                         |                            | 22.8900                   | 1.4151                        | 32.3915      |                                | (27)          |
| Velux (Uw = 1.40)                                              |                         |                            | 1.8400                    | 1.3258                        | 2.4394       |                                | (27a)         |
| Basement floor                                                 |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                                  | 3.4500                  |                            | 3.4500                    | 0.1200                        | 0.4140       |                                | (29a)         |
| External wall                                                  | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                   | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                        | 29.5200                 |                            | 29.5200                   | 0.1100                        | 3.2472       |                                | (30)          |
| skelling                                                       | 15.0200                 | 1.8400                     | 13.1800                   | 0.1600                        | 2.1088       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 59.2578      |                                | (33)          |
| Party Wall                                                     |                         |                            | 117.3000                  | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.0986 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 67.3564 (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                     | 78.0662  | 77.6916  | 77.3245  | 75.5999  | 75.2773  | 73.7753  | 73.7753  | 73.4971  | 74.3538  | 75.2773  | 75.9300  | 76.6124 (38)  |
| Heat transfer coeff       | 145.4225 | 145.0480 | 144.6808 | 142.9563 | 142.6336 | 141.1316 | 141.1316 | 140.8535 | 141.7102 | 142.6336 | 143.2864 | 143.9687 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 142.9547 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8808 | 0.8785 | 0.8763 | 0.8658 | 0.8639 | 0.8548 | 0.8548 | 0.8531 | 0.8583 | 0.8639 | 0.8678 | 0.8720 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8658 (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                        | 2.9560 (42)   |
| Average daily hot water use (litres/day) | 104.4043 (43) |

|                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924 | 110.6686 | 114.8447 (44) |
| Energy conte        | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428 | 151.8852 | 164.9375 (45) |

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|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------------|
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = | 1642.6862 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 25.5467  | 22.3433  | 23.0563  | 20.1010  | 19.2874  | 16.6436  | 15.4227  | 17.6978  | 17.9092  | 20.8714  | 22.7828  | 24.7406             | (46)           |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                     |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 250.0000            | (47)           |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 1.6000              | (48)           |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400              | (49)           |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.8640              | (55)           |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 26.7840  | 24.1920  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840             | (56)           |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 26.7840  | 24.1920  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840             | (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 |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 220.3578 | 194.1587 | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839            | (62)           |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | (63)           |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000              | (63)           |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 220.3578 | 194.1587 | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839            | (64)           |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 96.6657  | 85.6902  | 91.1453  | 83.3029  | 82.7909  | 75.6389  | 74.2242  | 79.2673  | 78.4443  | 86.3021  | 89.2474  | 94.8788             | (65)           |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 31.6246   | 28.0887   | 22.8433   | 17.2938   | 12.9273   | 10.9138   | 11.7928   | 15.3287   | 20.5741   | 26.1236   | 30.4900   | 32.5036   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 336.5285  | 340.0206  | 331.2206  | 312.4864  | 288.8379  | 266.6116  | 251.7631  | 248.2710  | 257.0710  | 275.8051  | 299.4537  | 321.6800  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 129.9270  | 127.5152  | 122.5071  | 115.6985  | 111.2781  | 105.0540  | 99.7637   | 106.5420  | 108.9504  | 115.9974  | 123.9548  | 127.5253  | (72) |
| Total internal gains                                                                | 565.4197  | 562.9641  | 543.9105  | 512.8183  | 480.3829  | 449.9190  | 430.6590  | 437.4812  | 453.9350  | 485.2657  | 521.2381  | 549.0484  | (73) |

#### 6. Solar gains

| [Jan]       |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g         | Specific data<br>or Table 6b | Specific data<br>or Table 6c | FF       | Access<br>factor<br>Table 6d | Gains<br>W    |               |
|-------------|----------|----------|-----------|------------|--------------------------------|-----------|------------------------------|------------------------------|----------|------------------------------|---------------|---------------|
| North       |          |          |           | 14.6700    | 10.6334                        |           | 0.6300                       |                              | 0.7000   | 0.7700                       | 47.6731 (74)  |               |
| South       |          |          |           | 8.2200     | 46.7521                        |           | 0.6300                       |                              | 0.7000   | 0.7700                       | 117.4477 (78) |               |
| North       |          |          |           | 0.9200     | 15.6897                        |           | 0.6300                       |                              | 0.7000   | 1.0000                       | 5.7291 (82)   |               |
| South       |          |          |           | 0.9200     | 45.6416                        |           | 0.6300                       |                              | 0.7000   | 1.0000                       | 16.6659 (82)  |               |
| <hr/>       |          |          |           |            |                                |           |                              |                              |          |                              |               |               |
| Solar gains | 187.5158 | 324.2638 | 463.7773  | 620.1197   | 744.6199                       | 763.5198  | 725.8407                     | 627.7395                     | 516.3042 | 363.1051                     | 225.3101      | 160.1100 (83) |
| Total gains | 752.9355 | 887.2279 | 1007.6878 | 1132.9380  | 1225.0028                      | 1213.4388 | 1156.4997                    | 1065.2207                    | 970.2392 | 848.3708                     | 746.5482      | 709.1585 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |      |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |         |      |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |      |
| tau                                                                         | 78.8459 | 79.0495 | 79.2501 | 80.2061 | 80.3876 | 81.2431 | 81.2431 | 81.4035 | 80.9114 | 80.3876 | 80.0214 | 79.6421 |      |
| alpha                                                                       | 6.2564  | 6.2700  | 6.2833  | 6.3471  | 6.3592  | 6.4162  | 6.4162  | 6.4269  | 6.3941  | 6.3592  | 6.3348  | 6.3095  |      |
| util living area                                                            | 0.9995  | 0.9986  | 0.9948  | 0.9754  | 0.8960  | 0.7121  | 0.5323  | 0.5982  | 0.8681  | 0.9875  | 0.9988  | 0.9997  | (86) |
| Tweekday                                                                    | 19.0969 | 19.2469 | 19.4800 | 19.7909 | 20.0307 | 20.1318 | 20.1430 | 20.1434 | 20.0889 | 19.7820 | 19.3870 | 19.0795 |      |
| Tweekend                                                                    | 20.4858 | 20.5514 | 20.6540 | 20.7906 | 20.9057 | 20.9612 | 20.9710 | 20.9695 | 20.9330 | 20.7845 | 20.6100 | 20.4754 |      |
| 24 / 16                                                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| 24 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| 16 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| MIT                                                                         | 20.2065 | 20.3061 | 20.4661 | 20.6730 | 20.8545 | 20.9404 | 20.9553 | 20.9529 | 20.8954 | 20.6674 | 20.3910 | 20.1904 | (87) |
| Th 2                                                                        | 20.1839 | 20.1858 | 20.1877 | 20.1966 | 20.1983 | 20.2061 | 20.2061 | 20.2076 | 20.2031 | 20.1983 | 20.1949 | 20.1914 | (88) |
| util rest of house                                                          | 0.9994  | 0.9981  | 0.9929  | 0.9660  | 0.8595  | 0.6368  | 0.4388  | 0.5004  | 0.8103  | 0.9813  | 0.9982  | 0.9996  | (89) |
| Tweekday                                                                    | 19.0969 | 19.2469 | 19.4800 | 19.7909 | 20.0307 | 20.1318 | 20.1430 | 20.1434 | 20.0889 | 19.7820 | 19.3870 | 19.0795 |      |
| Tweekend                                                                    | 19.0969 | 19.2469 | 19.4800 | 19.7909 | 20.0307 | 20.1318 | 20.1430 | 20.1434 | 20.0889 | 19.7820 | 19.3870 | 19.0795 |      |
| MIT 2                                                                       | 19.0969 | 19.2469 | 19.4800 | 19.7909 | 20.0307 | 20.1318 | 20.1430 | 20.1434 | 20.0889 | 19.7820 | 19.3870 | 19.0795 | (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         |      |
| MIT                                                                         | 19.2743 | 19.4163 | 19.6376 | 19.9319 | 20.1624 | 20.2611 | 20.2729 | 20.2728 | 20.2178 | 19.9235 | 19.5475 | 19.2572 | (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |      |
| adjusted MIT                                                                | 19.2743 | 19.4163 | 19.6376 | 19.9319 | 20.1624 | 20.2611 | 20.2729 | 20.2728 | 20.2178 | 19.9235 | 19.5475 | 19.2572 | (93) |

#### 8. Space heating requirement

|              |          |          |          |           |           |          |          |          |          |          |          |          |      |
|--------------|----------|----------|----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|------|
| Utilisation  | 0.9991   | 0.9974   | 0.9912   | 0.9622    | 0.8576    | 0.6423   | 0.4468   | 0.5087   | 0.8116   | 0.9784   | 0.9977   | 0.9994   | (94) |
| Useful gains | 752.2941 | 884.9480 | 998.8187 | 1090.0689 | 1050.6148 | 779.3883 | 516.6951 | 541.8684 | 787.4142 | 830.0843 | 744.8012 | 708.7445 | (95) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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

|                      |           |           |           |           |           |          |          |          |          |           |              |                |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|--------------|----------------|
| 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     | 2177.6025 | 2105.5563 | 1900.7623 | 1577.0841 | 1207.0223 | 798.9558 | 518.3601 | 545.5009 | 866.9581 | 1329.8513 | 1783.5597    | 2167.7593 (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    | 1060.4294 | 820.2488  | 671.0460  | 350.6509  | 116.3671  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.8266  | 747.9061     | 1085.5070 (98) |
| Space heating        |           |           |           |           |           |          |          |          |          |           |              | 5223.9821 (98) |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           | (98) / (4) = | 31.6394 (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 %)                      |           |          |          |          |          |          |          |          |          |          |          | 386.7589 (206)  |
| Efficiency of secondary/supplementary heating system, %               |           |          |          |          |          |          |          |          |          |          |          | 100.0000 (208)  |
| Space heating requirement                                             |           |          |          |          |          |          |          |          |          |          |          | 1350.7075 (211) |
| Jan                                                                   | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 1060.4294 | 820.2488 | 671.0460 | 350.6509 | 116.3671 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.8266 | 747.9061 | 1085.5070 (98)  |
| Space heating efficiency (main heating system 1)                      | 386.7589  | 386.7589 | 386.7589 | 386.7589 | 386.7589 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 386.7589 | 386.7589 | 386.7589 (210)  |
| Space heating fuel (main heating system)                              | 274.1836  | 212.0827 | 173.5050 | 90.6640  | 30.0878  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 96.1391  | 193.3779 | 280.6676 (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                                             | 220.3578  | 194.1587 | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839 (64)   |
| Efficiency of water heater                                            | 279.9650  | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 (216)  |
| (217)m                                                                | 279.9650  | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 (217)  |
| Fuel for water heating, kWh/month                                     | 78.7091   | 69.3510  | 72.7788  | 65.1649  | 63.8041  | 56.9318  | 54.6013  | 60.0189  | 59.9455  | 67.5760  | 71.5508  | 76.7896 (219)   |
| Water heating fuel used                                               |           |          |          |          |          |          |          |          |          |          |          | 797.2219 (219)  |
| Annual totals kWh/year                                                |           |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |           |          |          |          |          |          |          |          |          |          |          | 1350.7075 (211) |
| Space heating fuel - secondary                                        |           |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |           |          |          |          |          |          |          |          |          |          |          | 0.0000 (231)    |
| Total electricity for the above, kWh/year                             |           |          |          |          |          |          |          |          |          |          |          | 558.5009 (232)  |
| Electricity for lighting (calculated in Appendix L)                   |           |          |          |          |          |          |          |          |          |          |          | 2706.4303 (238) |
| Total delivered energy for all uses                                   |           |          |          |          |          |          |          |          |          |          |          |                 |

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               | 1350.7075          | 0.5190                        | 701.0172 (261)           |
| Space heating - secondary                   | 0.0000             | 0.5190                        | 0.0000 (263)             |
| Water heating (other fuel)                  | 797.2219           | 0.5190                        | 413.7581 (264)           |
| Space and water heating                     |                    |                               | 1114.7754 (265)          |
| Pumps and fans                              | 0.0000             | 0.0000                        | 0.0000 (267)             |
| Energy for lighting                         | 558.5009           | 0.5190                        | 289.8619 (268)           |
| Total CO2, kg/year                          |                    |                               | 1404.6373 (272)          |
| Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 8.5100 (273)             |

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

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 8.5100 ZC1  |
| Total Floor Area                                                                | TFA | 165.1100    |
| Assumed number of occupants                                                     | N   | 2.9560      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 12.0780 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.1504 ZC3  |
| Total CO2 emissions                                                             |     | 21.7384 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 21.7384 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m) | Volume<br>(m <sup>3</sup> )                    |
|--------------------------------------------------------|---------------------------|----------------------|------------------------------------------------|
| Basement floor                                         | 46.3700 (1a)              | x 2.3800 (2a)        | = 110.3606 (1a) - (3a)                         |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)        | = 123.8079 (1b) - (3b)                         |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)        | = 104.3546 (1c) - (3c)                         |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)        | = 76.1436 (1d) - (3d)                          |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 414.6667 (5) |
| Dwelling volume                                        |                           |                      |                                                |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3239 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3460 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opaque door                                             |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| TER Opening Type (Uw = 1.40)                                |                         |                            | 22.8900                   | 1.3258                        | 30.3466      |                                | (27)          |
| TER Room Window (Uw = 1.70)                                 |                         |                            | 1.8400                    | 1.5918                        | 2.9288       |                                | (27a)         |
| Basement floor                                              |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                               | 3.4500                  |                            | 3.4500                    | 0.1800                        | 0.6210       |                                | (29a)         |
| External wall                                               | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                     | 29.5200                 |                            | 29.5200                   | 0.1300                        | 3.8376       |                                | (30)          |
| skelling                                                    | 15.0200                 | 1.8400                     | 13.1800                   | 0.1300                        | 1.7134       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 58.1043      |                                | (33)          |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 250.0000 (35)  
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.4158 (36)  
Total fabric heat loss (33) + (36) = 71.5201 (37)

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |          |          |          |          |          |          |          |          |          |          |          |               |
| (38)m                                                               | 78.0662  | 77.6916  | 77.3245  | 75.5999  | 75.2773  | 73.7753  | 73.7753  | 73.4971  | 74.3538  | 75.2773  | 75.9300  | 76.6124 (38)  |
| Heat transfer coeff                                                 | 149.5863 | 149.2117 | 148.8446 | 147.1201 | 146.7974 | 145.2954 | 145.2954 | 145.0173 | 145.8740 | 146.7974 | 147.4501 | 148.1325 (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 147.1185 (39) |
| HLP                                                                 | 0.9060   | 0.9037   | 0.9015   | 0.8910   | 0.8891   | 0.8800   | 0.8800   | 0.8783   | 0.8835   | 0.8891   | 0.8930   | 0.8972 (40)   |
| HLP (average)                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.8910 (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                        |          |          |          |          |          |          |          |          |          |                    |          | 2.9560 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |          |          |          |                    |          | 104.4043 (43)  |
| Daily hot water use                      | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924           | 110.6686 | 114.8447 (44)  |
| Energy conte                             | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428           | 151.8852 | 164.9375 (45)  |
| Energy content (annual)                  |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 1642.6862 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                                                                   |         |         |         |         |         |         |         |         |         |         |         |                |
|-------------------------------------------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------------|
| Distribution loss (46)m = 0.15 x (45)m                                                                            | 25.5467 | 22.3433 | 23.0563 | 20.1010 | 19.2874 | 16.6436 | 15.4227 | 17.6978 | 17.9092 | 20.8714 | 22.7828 | 24.7406 (46)   |
| Water storage loss:                                                                                               |         |         |         |         |         |         |         |         |         |         |         |                |
| Store volume                                                                                                      |         |         |         |         |         |         |         |         |         |         |         | 250.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day):                                                       |         |         |         |         |         |         |         |         |         |         |         | 1.8903 (48)    |
| Temperature factor from Table 2b                                                                                  |         |         |         |         |         |         |         |         |         |         |         | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                                                                        |         |         |         |         |         |         |         |         |         |         |         | 1.0208 (55)    |
| Total storage loss                                                                                                |         |         |         |         |         |         |         |         |         |         |         |                |
| 31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (56)              |         |         |         |         |         |         |         |         |         |         |         |                |
| If cylinder contains dedicated solar storage                                                                      |         |         |         |         |         |         |         |         |         |         |         |                |
| 31.6444 28.5820 31.6444 30.6236 31.6444 30.6236 31.6444 31.6444 30.6236 31.6444 30.6236 31.6444 (57)              |         |         |         |         |         |         |         |         |         |         |         |                |
| Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 (59) |         |         |         |         |         |         |         |         |         |         |         |                |
| Total heat required for water heating calculated for each month                                                   |         |         |         |         |         |         |         |         |         |         |         |                |
| 225.2182 198.5487 208.6155 187.1426 183.4897 164.0928 157.7250 172.8922 172.5301 194.0496 205.0208 219.8443 (62)  |         |         |         |         |         |         |         |         |         |         |         |                |
| Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)              |         |         |         |         |         |         |         |         |         |         |         |                |
| Solar input (sum of months) = Sum(63)m =                                                                          |         |         |         |         |         |         |         |         |         |         |         | 0.0000 (63)    |
| Output from w/h                                                                                                   |         |         |         |         |         |         |         |         |         |         |         |                |
| 225.2182 198.5487 208.6155 187.1426 183.4897 164.0928 157.7250 172.8922 172.5301 194.0496 205.0208 219.8443 (64)  |         |         |         |         |         |         |         |         |         |         |         |                |
| Total per year (kWh/year) = Sum(64)m =                                                                            |         |         |         |         |         |         |         |         |         |         |         | 2289.1693 (64) |
| Heat gains from water heating, kWh/month                                                                          |         |         |         |         |         |         |         |         |         |         |         |                |
| 100.5540 89.2023 95.0336 87.0658 86.6792 79.4018 78.1125 83.1556 82.2072 90.1904 93.0103 98.7672 (65)             |         |         |         |         |         |         |         |         |         |         |         |                |

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

|                                                                                                                              |          |          |          |          |          |          |          |          |          |          |          |               |
|------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                                                                        | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 | 147.7985 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5                                              |          |          |          |          |          |          |          |          |          |          |          |               |
| 31.6246 28.0887 22.8433 17.2938 12.9273 10.9138 11.7928 15.3287 20.5741 26.1236 30.4900 32.5036 (67)                         |          |          |          |          |          |          |          |          |          |          |          |               |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5                                          |          |          |          |          |          |          |          |          |          |          |          |               |
| 336.5285 340.0206 331.2206 312.4864 288.8379 266.6116 251.7631 248.2710 257.0710 275.8051 299.4537 321.6800 (68)             |          |          |          |          |          |          |          |          |          |          |          |               |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| 37.7799 37.7799 37.7799 37.7799 37.7799 37.7799 37.7799 37.7799 37.7799 37.7799 37.7799 37.7799 (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)                                                                          |          |          |          |          |          |          |          |          |          |          |          |               |
| -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 -118.2388 (71) |          |          |          |          |          |          |          |          |          |          |          |               |
| Water heating gains (Table 5)                                                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
| 135.1532 132.7415 127.7333 120.9247 116.5043 110.2802 104.9899 111.7682 114.1766 121.2237 129.1810 132.7516 (72)             |          |          |          |          |          |          |          |          |          |          |          |               |
| Total internal gains                                                                                                         |          |          |          |          |          |          |          |          |          |          |          |               |
| 573.6459 571.1904 552.1367 521.0445 488.6091 458.1452 438.8853 445.7074 462.1612 493.4919 529.4643 557.2747 (73)             |          |          |          |          |          |          |          |          |          |          |          |               |

#### 6. Solar gains

|       |            |                                |                              |                                    |                              |               |
|-------|------------|--------------------------------|------------------------------|------------------------------------|------------------------------|---------------|
| [Jan] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | Specific data<br>FF<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |
| North | 14.6700    | 10.6334                        | 0.6300                       | 0.7000                             | 0.7700                       | 47.6731 (74)  |
| South | 8.2200     | 46.7521                        | 0.6300                       | 0.7000                             | 0.7700                       | 117.4477 (78) |
| North | 0.9200     | 15.6897                        | 0.6300                       | 0.7000                             | 1.0000                       | 5.7291 (82)   |
| South | 0.9200     | 45.6416                        | 0.6300                       | 0.7000                             | 1.0000                       | 16.6659 (82)  |

|             |          |          |           |           |           |           |           |           |          |          |          |               |
|-------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|---------------|
| Solar gains | 187.5158 | 324.2638 | 463.7773  | 620.1197  | 744.6199  | 763.5198  | 725.8407  | 627.7395  | 516.3042 | 363.1051 | 225.3101 | 160.1100 (83) |
| Total gains | 761.1617 | 895.4541 | 1015.9140 | 1141.1643 | 1233.2290 | 1221.6650 | 1164.7259 | 1073.4469 | 978.4654 | 856.5970 | 754.7744 | 717.3847 (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 76.6512 76.8436 77.0332 77.9362 78.1075 78.9149 78.9149 79.0663 78.6019 78.1075 77.7617 77.4035               |  |  |  |  |  |  |  |  |  |  |  |              |
| alpha 6.1101 6.1229 6.1355 6.1957 6.2072 6.2610 6.2610 6.2711 6.2401 6.2072 6.1841 6.1602                         |  |  |  |  |  |  |  |  |  |  |  |              |
| util living area 0.9995 0.9985 0.9948 0.9762 0.9010 0.7230 0.5430 0.6091 0.8738 0.9877 0.9987 0.9997 (86)         |  |  |  |  |  |  |  |  |  |  |  |              |
| MIT 19.9658 20.1018 20.3163 20.6023 20.8483 20.9721 20.9959 20.9921 20.9094 20.5935 20.2268 19.9437 (87)          |  |  |  |  |  |  |  |  |  |  |  |              |
| Th 2 20.1624 20.1643 20.1662 20.1751 20.1768 20.1845 20.1845 20.1860 20.1816 20.1768 20.1734 20.1699 (88)         |  |  |  |  |  |  |  |  |  |  |  |              |
| util rest of house 0.9993 0.9980 0.9929 0.9670 0.8651 0.6460 0.4456 0.5077 0.8163 0.9814 0.9982 0.9996 (89)       |  |  |  |  |  |  |  |  |  |  |  |              |
| MIT 18.7569 18.9572 19.2714 19.6896 20.0215 20.1651 20.1829 20.1824 20.1041 19.6825 19.1471 18.7301 (90)          |  |  |  |  |  |  |  |  |  |  |  |              |
| Living area fraction fLA = Living area / (4) =                                                                    |  |  |  |  |  |  |  |  |  |  |  | 0.1599 (91)  |
| MIT 18.9502 19.1402 19.4385 19.8356 20.1537 20.2942 20.3129 20.3119 20.2329 19.8281 19.3197 18.9242 (92)          |  |  |  |  |  |  |  |  |  |  |  |              |
| Temperature adjustment 0.0000                                                                                     |  |  |  |  |  |  |  |  |  |  |  |              |
| adjusted MIT 18.9502 19.1402 19.4385 19.8356 20.1537 20.2942 20.3129 20.3119 20.2329 19.8281 19.3197 18.9242 (93) |  |  |  |  |  |  |  |  |  |  |  |              |

#### 8. Space heating requirement

|                                                                                                                                  |     |     |     |     |     |     |     |     |     |     |     |     |
|----------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Utilisation                                                                                                                      | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 0.9990 0.9971 0.9906 0.9622 0.8639 0.6570 0.4612 0.5239 0.8204 0.9778 0.9973 0.9993 (94)                                         |     |     |     |     |     |     |     |     |     |     |     |     |
| Useful gains 760.3849 892.8387 1006.3292 1098.0207 1065.4277 802.6059 537.1192 562.3431 802.7782 837.5894 752.7514 716.8745 (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                                                                                                                 |     |     |     |     |     |     |     |     |     |     |     |     |
| 2191.4662 2124.8100 1925.8224 1608.8405 1240.9825 827.3345 539.4668 567.2932 894.6274 1354.6661 1801.7975 2181.1316 (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                                                                                                                |     |     |     |     |     |     |     |     |     |     |     |     |
| 1064.7245 827.8847 684.1030 367.7902 130.6128 0.0000 0.0000 0.0000 0.0000 384.7051 755.3132 1089.4073 (98)                       |     |     |     |     |     |     |     |     |     |     |     |     |
| Space heating 5304.5408 (98)                                                                                                     |     |     |     |     |     |     |     |     |     |     |     |     |
| Space heating per m2 (98) / (4) = 32.1273 (99)                                                                                   |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)                      |           |          |          |          |          |          |          |          |          |          |          |           | 93.5000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |           |          |          |          |          |          |          |          |          |          |          |           | 0.0000    | (208)  |
| Space heating requirement                                             |           |          |          |          |          |          |          |          |          |          |          |           | 5673.3056 | (211)  |
|                                                                       | Jan       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |           |        |
| Space heating requirement                                             | 1064.7245 | 827.8847 | 684.1030 | 367.7902 | 130.6128 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 384.7051 | 755.3132 | 1089.4073 | (98)      |        |
| Space heating efficiency (main heating system 1)                      | 93.5000   | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)     |        |
| Space heating fuel (main heating system)                              | 1138.7428 | 885.4381 | 731.6609 | 393.3585 | 139.6928 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 411.4493 | 807.8216 | 1165.1415 | (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                                             | 225.2182  | 198.5487 | 208.6155 | 187.1426 | 183.4897 | 164.0928 | 157.7250 | 172.8922 | 172.5301 | 194.0496 | 205.0208 | 219.8443  | (64)      |        |
| Efficiency of water heater (217)m                                     | 88.4298   | 88.2121  | 87.7504  | 86.5848  | 83.9262  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.6064  | 87.9815  | 88.5073   | (216)     |        |
| Fuel for water heating, kWh/month                                     | 254.6859  | 225.0811 | 237.7372 | 216.1379 | 218.6322 | 205.6301 | 197.6503 | 216.6568 | 216.2031 | 224.0591 | 233.0273 | 248.3913  | (219)     |        |
| Water heating fuel used                                               |           |          |          |          |          |          |          |          |          |          |          | 2693.8924 | (219)     |        |
| Annual totals kWh/year                                                |           |          |          |          |          |          |          |          |          |          |          |           |           |        |
| Space heating fuel - main system                                      |           |          |          |          |          |          |          |          |          |          |          | 5673.3056 | (211)     |        |
| Space heating fuel - secondary                                        |           |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)     |        |
| Electricity for pumps and fans:                                       |           |          |          |          |          |          |          |          |          |          |          |           |           |        |
| central heating pump                                                  |           |          |          |          |          |          |          |          |          |          |          |           | 30.0000   | (230c) |
| main heating flue fan                                                 |           |          |          |          |          |          |          |          |          |          |          |           | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |           |          |          |          |          |          |          |          |          |          |          |           | 75.0000   | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |           |          |          |          |          |          |          |          |          |          |          |           | 558.5009  | (232)  |
| Total delivered energy for all uses                                   |           |          |          |          |          |          |          |          |          |          |          |           | 9000.6990 | (238)  |

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

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 5673.3056          | 0.2160                        | 1225.4340 (261)          |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2693.8924          | 0.2160                        | 581.8808 (264)           |
| Space and water heating                                                                           |                    |                               | 1807.3148 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 558.5009           | 0.5190                        | 289.8619 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 2136.1017 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 10.9461 (272a)           |
| Fuel factor (electricity)                                                                         |                    |                               | 1.5500                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 1.7556 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.2358 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (10.9461 * 1.55) + 1.7556 + 0.2358, rounded to 2 d.p. |                    |                               | 18.9600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m) | Volume<br>(m <sup>3</sup> )                            |
|--------------------------------------------------------|---------------------------|----------------------|--------------------------------------------------------|
| Basement floor                                         | 46.3700 (1a)              | x 2.3800 (2a)        | = 110.3606 (1a) - (3a)                                 |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)        | = 123.8079 (1b) - (3b)                                 |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)        | = 104.3546 (1c) - (3c)                                 |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)        | = 76.1436 (1d) - (3d)                                  |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                      | (3a) + (3b) + (3c) + (3d) + (3e)...(3n) = 414.6667 (5) |
| Dwelling volume                                        |                           |                      |                                                        |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3239 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3460 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

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

| Element                                                        | Gross<br>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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Door -1                                                        |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| W-1.5 (Uw = 1.50)                                              |                         |                            | 22.8900                   | 1.4151                        | 32.3915      |                                | (27)          |
| Velux (Uw = 1.40)                                              |                         |                            | 1.8400                    | 1.3258                        | 2.4394       |                                | (27a)         |
| Basement floor                                                 |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                                  | 3.4500                  |                            | 3.4500                    | 0.1200                        | 0.4140       |                                | (29a)         |
| External wall                                                  | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                   | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                        | 29.5200                 |                            | 29.5200                   | 0.1100                        | 3.2472       |                                | (30)          |
| skelling                                                       | 15.0200                 | 1.8400                     | 13.1800                   | 0.1600                        | 2.1088       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 59.2578      |                                | (33)          |
| Party Wall                                                     |                         |                            | 117.3000                  | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.0986 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 67.3564 (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                     | 78.0662  | 77.6916  | 77.3245  | 75.5999  | 75.2773  | 73.7753  | 73.7753  | 73.4971  | 74.3538  | 75.2773  | 75.9300  | 76.6124 (38)  |
| Heat transfer coeff       | 145.4225 | 145.0480 | 144.6808 | 142.9563 | 142.6336 | 141.1316 | 141.1316 | 140.8535 | 141.7102 | 142.6336 | 143.2864 | 143.9687 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 142.9547 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8808 | 0.8785 | 0.8763 | 0.8658 | 0.8639 | 0.8548 | 0.8548 | 0.8531 | 0.8583 | 0.8639 | 0.8678 | 0.8720 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8658 (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                        |          |          |          |          |          |          |          |          |          |          |          | 2.9560 (42)   |
|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Average daily hot water use (litres/day) |          |          |          |          |          |          |          |          |          |          |          | 104.4043 (43) |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Daily hot water use                      | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924 | 110.6686 | 114.8447 (44) |
| Energy conte                             | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428 | 151.8852 | 164.9375 (45) |

Regs Region: England

Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.14r16

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                              |                                   |         |         |         |         |         |         |         |         |         |         |              |
|----------------------------------------------|-----------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Energy content (annual)                      | Total = Sum(45)m = 1642.6862 (45) |         |         |         |         |         |         |         |         |         |         |              |
| Distribution loss (46)m = 0.15 x (45)m       | 0.0000                            | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (46)  |
| Water storage loss:                          |                                   |         |         |         |         |         |         |         |         |         |         |              |
| Total storage loss                           | 0.0000                            | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (56)  |
| If cylinder contains dedicated solar storage | 0.0000                            | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (57)  |
| Primary loss                                 | 0.0000                            | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (59)  |
| Heat gains from water heating, kWh/month     | 36.1912                           | 31.6530 | 32.6631 | 28.4765 | 27.3239 | 23.5784 | 21.8489 | 25.0719 | 25.3713 | 29.5678 | 32.2756 | 35.0492 (65) |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 31.6246   | 28.0887   | 22.8433   | 17.2938   | 12.9273   | 10.9138   | 11.7928   | 15.3287   | 20.5741   | 26.1236   | 30.4900   | 32.5036   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 336.5285  | 340.0206  | 331.2206  | 312.4864  | 288.8379  | 266.6116  | 251.7631  | 248.2710  | 257.0710  | 275.8051  | 299.4537  | 321.6800  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | (71) |
| Water heating gains (Table 5)                                                       | 48.6441   | 47.1027   | 43.9020   | 39.5507   | 36.7256   | 32.7478   | 29.3668   | 33.6988   | 35.2380   | 39.7417   | 44.8272   | 47.1092   | (72) |
| Total internal gains                                                                | 484.1368  | 482.5516  | 465.3055  | 436.6705  | 405.8304  | 377.6128  | 360.2621  | 364.6380  | 380.2226  | 409.0100  | 442.1105  | 468.6323  | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |          |          |          |      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|----------|----------|----------|------|
| North       |          |          |          | 14.6700    | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       | 47.6731 (74)  |          |          |          |      |
| South       |          |          |          | 8.2200     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       | 117.4477 (78) |          |          |          |      |
| North       |          |          |          | 0.9200     | 15.6897                        | 0.6300                            | 0.7000                             | 1.0000                       | 5.7291 (82)   |          |          |          |      |
| South       |          |          |          | 0.9200     | 45.6416                        | 0.6300                            | 0.7000                             | 1.0000                       | 16.6659 (82)  |          |          |          |      |
| Solar gains | 187.5158 | 324.2638 | 463.7773 | 620.1197   | 744.6199                       | 763.5198                          | 725.8407                           | 627.7395                     | 516.3042      | 363.1051 | 225.3101 | 160.1100 | (83) |
| Total gains | 671.6526 | 806.8154 | 929.0827 | 1056.7902  | 1150.4503                      | 1141.1326                         | 1086.1028                          | 992.3775                     | 896.5268      | 772.1150 | 667.4206 | 628.7423 | (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 78.8459 | 79.0495 | 79.2501 | 80.2061 | 80.3876 | 81.2431 | 81.2431 | 81.4035 | 80.9114 | 80.3876 | 80.0214 | 79.6421 |              |
| alpha                                                                       | 6.2564  | 6.2700  | 6.2833  | 6.3471  | 6.3592  | 6.4162  | 6.4162  | 6.4269  | 6.3941  | 6.3592  | 6.3348  | 6.3095  |              |
| util living area                                                            | 0.9998  | 0.9992  | 0.9967  | 0.9825  | 0.9174  | 0.7468  | 0.5649  | 0.6376  | 0.8992  | 0.9924  | 0.9993  | 0.9998  | (86)         |
| MIT                                                                         | 19.9490 | 20.0850 | 20.2984 | 20.5852 | 20.8373 | 20.9693 | 20.9955 | 20.9909 | 20.8969 | 20.5697 | 20.2057 | 19.9275 | (87)         |
| Th 2                                                                        | 20.1839 | 20.1858 | 20.1877 | 20.1966 | 20.1983 | 20.2061 | 20.2061 | 20.2076 | 20.2031 | 20.1983 | 20.1949 | 20.1914 | (88)         |
| util rest of house                                                          | 0.9997  | 0.9989  | 0.9954  | 0.9755  | 0.8856  | 0.6716  | 0.4667  | 0.5356  | 0.8487  | 0.9884  | 0.9991  | 0.9998  | (89)         |
| MIT 2                                                                       | 19.2039 | 19.3413 | 19.5558 | 19.8463 | 20.0823 | 20.1912 | 20.2049 | 20.2047 | 20.1407 | 19.8347 | 19.4697 | 19.1886 | (90)         |
| Living area fraction                                                        | 19.3230 | 19.4602 | 19.6746 | 19.9644 | 20.2030 | 20.3156 | 20.3313 | 20.3304 | 20.2616 | 19.9522 | 19.5874 | 19.3068 | (92)         |
| Temperature adjustment                                                      | 19.3230 | 19.4602 | 19.6746 | 19.9644 | 20.2030 | 20.3156 | 20.3313 | 20.3304 | 20.2616 | 19.9522 | 19.5874 | 19.3068 | (93)         |
| adjusted MIT                                                                | 19.3230 | 19.4602 | 19.6746 | 19.9644 | 20.2030 | 20.3156 | 20.3313 | 20.3304 | 20.2616 | 19.9522 | 19.5874 | 19.3068 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |           |          |          |          |          |           |           |           |                |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |                |
| Useful gains         | 671.3622  | 805.6190  | 923.8449  | 1028.1912 | 1019.0915 | 779.0110 | 523.9809 | 547.7830 | 764.8002 | 761.8830  | 666.6098  | 628.5646  | (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     | 2184.6851 | 2111.9301 | 1906.1058 | 1581.7327 | 1212.8191 | 806.6562 | 526.6006 | 553.6100 | 873.1575 | 1333.9452 | 1789.2678 | 2174.9034 | (97)           |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | 1.0000    | (97a)          |
| Space heating kWh    | 1125.9122 | 877.8411  | 730.8021  | 398.5499  | 144.1334  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 425.6143  | 808.3138  | 1150.4761 | (98)           |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           |           | 5661.6429 (98) |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           |           | 34.2901 (99)   |

#### 8c. Space cooling requirement

|                                                     |        |        |        |        |         |         |         |         |         |         |        |        |  |
|-----------------------------------------------------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|--------|--------|--|
| Calculated for June, July and August. See Table 10b | Jan    | Feb    | Mar    | Apr    | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov    | Dec    |  |
| Ext. temp.                                          | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 |  |
| Heat loss rate W                                    |        |        |        |        |         |         |         |         |         |         |        |        |  |

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## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |        |        |        |        |        |           |           |           |                          |        |        |                |
|------------------------------------------|--------|--------|--------|--------|--------|-----------|-----------|-----------|--------------------------|--------|--------|----------------|
| Utilisation                              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1326.6374 | 1044.3741 | 1070.4865 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (100)   |
| Useful loss                              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.8988    | 0.9531    | 0.9282    | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (101)   |
| Total gains                              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1192.4328 | 995.3487  | 993.5780  | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (102)   |
| Month fracti                             | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1443.7206 | 1377.6019 | 1274.4587 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (103)   |
| Space cooling kWh                        | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000    | 1.0000    | 1.0000    | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (103a)  |
| Space cooling                            | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 180.9272  | 284.3964  | 208.9752  | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (104)   |
| Cooled fraction                          |        |        |        |        |        |           |           |           | fC = cooled area / (4) = |        |        | 674.2988 (104) |
| Intermittency factor (Table 10b)         |        |        |        |        |        |           |           |           |                          |        |        | 1.0000 (105)   |
| Space cooling kWh                        | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500    | 0.2500    | 0.2500    | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (106)   |
| Space cooling                            | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 45.2318   | 71.0991   | 52.2438   | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling per m2                     |        |        |        |        |        |           |           |           |                          |        |        | 168.5747 (107) |
| Energy for space heating                 |        |        |        |        |        |           |           |           |                          |        |        | 1.0210 (108)   |
| Energy for space cooling                 |        |        |        |        |        |           |           |           |                          |        |        | 34.2901 (99)   |
| Total                                    |        |        |        |        |        |           |           |           |                          |        |        | 1.0210 (108)   |
| Dwelling Fabric Energy Efficiency (DFEE) |        |        |        |        |        |           |           |           |                          |        |        | 35.3111 (109)  |
|                                          |        |        |        |        |        |           |           |           |                          |        |        | 35.3 (109)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m) | Volume<br>(m <sup>3</sup> )                    |
|--------------------------------------------------------|---------------------------|----------------------|------------------------------------------------|
| Basement floor                                         | 46.3700 (1a)              | x 2.3800 (2a)        | = 110.3606 (1a) - (3a)                         |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)        | = 123.8079 (1b) - (3b)                         |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)        | = 104.3546 (1c) - (3c)                         |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)        | = 76.1436 (1d) - (3d)                          |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 414.6667 (5) |
| Dwelling volume                                        |                           |                      |                                                |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3239 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3460 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

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

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Opaque door                                             |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| TER Opening Type (Uw = 1.40)                                |                         |                            | 22.8900                   | 1.3258                        | 30.3466      |                                | (27)          |
| TER Room Window (Uw = 1.70)                                 |                         |                            | 1.8400                    | 1.5918                        | 2.9288       |                                | (27a)         |
| Basement floor                                              |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                               | 3.4500                  |                            | 3.4500                    | 0.1800                        | 0.6210       |                                | (29a)         |
| External wall                                               | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                     | 29.5200                 |                            | 29.5200                   | 0.1300                        | 3.8376       |                                | (30)          |
| skelling                                                    | 15.0200                 | 1.8400                     | 13.1800                   | 0.1300                        | 1.7134       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 58.1043      |                                | (33)          |

|                                                                |                            |
|----------------------------------------------------------------|----------------------------|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     | 13.4158 (36)               |
| Total fabric heat loss                                         | (33) + (36) = 71.5201 (37) |

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |          |          |          |          |          |          |          |          |          |          |          |               |
| (38)m                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|                                                                     | 78.0662  | 77.6916  | 77.3245  | 75.5999  | 75.2773  | 73.7753  | 73.7753  | 73.4971  | 74.3538  | 75.2773  | 75.9300  | 76.6124 (38)  |
| Heat transfer coeff                                                 | 149.5863 | 149.2117 | 148.8446 | 147.1201 | 146.7974 | 145.2954 | 145.2954 | 145.0173 | 145.8740 | 146.7974 | 147.4501 | 148.1325 (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 147.1185 (39) |
| HLP                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| HLP (average)                                                       | 0.9060   | 0.9037   | 0.9015   | 0.8910   | 0.8891   | 0.8800   | 0.8800   | 0.8783   | 0.8835   | 0.8891   | 0.8930   | 0.8972 (40)   |
| Days in month                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.8910 (40)   |
|                                                                     | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31 (41)       |

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

|                                          |              |              |              |              |             |             |             |             |              |                    |              |                   |
|------------------------------------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|--------------|--------------------|--------------|-------------------|
| Assumed occupancy                        |              |              |              |              |             |             |             |             |              |                    |              | 2.9560 (42)       |
| Average daily hot water use (litres/day) |              |              |              |              |             |             |             |             |              |                    |              | 104.4043 (43)     |
| Daily hot water use                      | Jan 114.8447 | Feb 110.6686 | Mar 106.4924 | Apr 102.3162 | May 98.1400 | Jun 93.9639 | Jul 93.9639 | Aug 98.1400 | Sep 102.3162 | Oct 106.4924       | Nov 110.6686 | Dec 114.8447 (44) |
| Energy conte                             | 170.3114     | 148.9555     | 153.7087     | 134.0070     | 128.5829    | 110.9572    | 102.8182    | 117.9854    | 119.3945     | 139.1428           | 151.8852     | 164.9375 (45)     |
| Energy content (annual)                  |              |              |              |              |             |             |             |             |              | Total = Sum(45)m = |              | 1642.6862 (45)    |

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Services Ltd.

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|                                              |         |         |         |         |         |         |         |         |         |         |         |              |
|----------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Distribution loss (46)m = 0.15 x (45)m       | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (46)  |
| Water storage loss:                          |         |         |         |         |         |         |         |         |         |         |         |              |
| Total storage loss                           | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (56)  |
| If cylinder contains dedicated solar storage | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (57)  |
| Primary loss                                 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (59)  |
| Heat gains from water heating, kWh/month     | 36.1912 | 31.6530 | 32.6631 | 28.4765 | 27.3239 | 23.5784 | 21.8489 | 25.0719 | 25.3713 | 29.5678 | 32.2756 | 35.0492 (65) |

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

| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| (66)m                                                                               | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985  | 147.7985 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 31.6246   | 28.0887   | 22.8433   | 17.2938   | 12.9273   | 10.9138   | 11.7928   | 15.3287   | 20.5741   | 26.1236   | 30.4900   | 32.5036 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 336.5285  | 340.0206  | 331.2206  | 312.4864  | 288.8379  | 266.6116  | 251.7631  | 248.2710  | 257.0710  | 275.8051  | 299.4537  | 321.6800 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799   | 37.7799 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 (71) |
| Water heating gains (Table 5)                                                       | 48.6441   | 47.1027   | 43.9020   | 39.5507   | 36.7256   | 32.7478   | 29.3668   | 33.6988   | 35.2380   | 39.7417   | 44.8272   | 47.1092 (72)   |
| Total internal gains                                                                | 484.1368  | 482.5516  | 465.3055  | 436.6705  | 405.8304  | 377.6128  | 360.2621  | 364.6380  | 380.2226  | 409.0100  | 442.1105  | 468.6323 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|-----------|------------------------------------|----------|------------------------------|----------|---------------|
| North       |          |          |          | 14.6700    | 10.6334                        | 0.6300                            |           | 0.7000                             |          | 0.7700                       |          | 47.6731 (74)  |
| South       |          |          |          | 8.2200     | 46.7521                        | 0.6300                            |           | 0.7000                             |          | 0.7700                       |          | 117.4477 (78) |
| North       |          |          |          | 0.9200     | 15.6897                        | 0.6300                            |           | 0.7000                             |          | 1.0000                       |          | 5.7291 (82)   |
| South       |          |          |          | 0.9200     | 45.6416                        | 0.6300                            |           | 0.7000                             |          | 1.0000                       |          | 16.6659 (82)  |
|             |          |          |          |            |                                |                                   |           |                                    |          |                              |          |               |
| Solar gains | 187.5158 | 324.2638 | 463.7773 | 620.1197   | 744.6199                       | 763.5198                          | 725.8407  | 627.7395                           | 516.3042 | 363.1051                     | 225.3101 | 160.1100 (83) |
| Total gains | 671.6526 | 806.8154 | 929.0827 | 1056.7902  | 1150.4503                      | 1141.1326                         | 1086.1028 | 992.3775                           | 896.5268 | 772.1150                     | 667.4206 | 628.7423 (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                                                                         | 76.6512 | 76.8436 | 77.0332 | 77.9362 | 78.1075 | 78.9149 | 78.9149 | 79.0663 | 78.6019 | 78.1075 | 77.7617 | 77.4035      |
| alpha                                                                       | 6.1101  | 6.1229  | 6.1355  | 6.1957  | 6.2072  | 6.2610  | 6.2610  | 6.2711  | 6.2401  | 6.2072  | 6.1841  | 6.1602       |
| util living area                                                            | 0.9998  | 0.9992  | 0.9968  | 0.9836  | 0.9233  | 0.7608  | 0.5797  | 0.6529  | 0.9065  | 0.9928  | 0.9993  | 0.9998 (86)  |
| MIT                                                                         | 19.9127 | 20.0494 | 20.2659 | 20.5578 | 20.8190 | 20.9631 | 20.9942 | 20.9885 | 20.8841 | 20.5460 | 20.1750 | 19.8910 (87) |
| Th 2                                                                        | 20.1624 | 20.1643 | 20.1662 | 20.1751 | 20.1768 | 20.1845 | 20.1845 | 20.1860 | 20.1816 | 20.1768 | 20.1734 | 20.1699 (88) |
| util rest of house                                                          | 0.9997  | 0.9989  | 0.9955  | 0.9769  | 0.8927  | 0.6845  | 0.4770  | 0.5471  | 0.8573  | 0.9889  | 0.9991  | 0.9998 (89)  |
| MIT 2                                                                       | 19.1497 | 19.2879 | 19.5054 | 19.8012 | 20.0469 | 20.1664 | 20.1829 | 20.1823 | 20.1107 | 19.7932 | 19.4210 | 19.1342 (90) |
| Living area fraction                                                        | 19.2717 | 19.4097 | 19.6270 | 19.9221 | 20.1704 | 20.2938 | 20.3126 | 20.3112 | 20.2343 | 19.9136 | 19.5416 | 19.2552 (92) |
| MIT                                                                         | 19.2717 | 19.4097 | 19.6270 | 19.9221 | 20.1704 | 20.2938 | 20.3126 | 20.3112 | 20.2343 | 19.9136 | 19.5416 | 19.2552 (93) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.2717 | 19.4097 | 19.6270 | 19.9221 | 20.1704 | 20.2938 | 20.3126 | 20.3112 | 20.2343 | 19.9136 | 19.5416 | 19.2552 (93) |

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                       |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|---------------------------|
| Utilisation          | 0.9996    | 0.9985    | 0.9945    | 0.9743    | 0.8924    | 0.6955   | 0.4935   | 0.5641   | 0.8611   | 0.9872    | 0.9988    | 0.9997 (94)               |
| Useful gains         | 671.3528  | 805.6135  | 923.9643  | 1029.6098 | 1026.6304 | 793.6565 | 536.0108 | 559.7916 | 771.9711 | 762.2697  | 666.6027  | 628.5572 (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     | 2239.5554 | 2165.0135 | 1953.8829 | 1621.5782 | 1243.4324 | 827.2844 | 539.4270 | 567.1982 | 894.8414 | 1367.2111 | 1834.5097 | 2230.1594 (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    | 1166.7427 | 913.5168  | 766.2594  | 426.2173  | 161.3007  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 450.0764  | 840.8930  | 1191.5920 (98)            |
| Space heating        |           |           |           |           |           |          |          |          |          |           |           | 5916.5982 (98)            |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           |           | (98) / (4) = 35.8343 (99) |

#### 8c. Space cooling requirement

| Calculated for June, July and August. See Table 10b |        |        |        |        |         |           |           |           |         |         |        |              |
|-----------------------------------------------------|--------|--------|--------|--------|---------|-----------|-----------|-----------|---------|---------|--------|--------------|
|                                                     | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul       | Aug       | Sep     | Oct     | Nov    | Dec          |
| Ext. temp.                                          | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000   | 16.6000   | 16.4000   | 14.1000 | 10.6000 | 7.1000 | 4.2000       |
| Heat loss rate W                                    | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1365.7769 | 1075.1861 | 1102.1312 | 0.0000  | 0.0000  | 0.0000 | 0.0000 (100) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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

|                                        |        |        |        |        |        |           |           |           |                          |        |        |                |
|----------------------------------------|--------|--------|--------|--------|--------|-----------|-----------|-----------|--------------------------|--------|--------|----------------|
| Utilisation                            | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.8850    | 0.9443    | 0.9166    | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (101)   |
| Useful loss                            | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1208.7228 | 1015.2718 | 1010.2598 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (102)   |
| Total gains                            | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1443.7206 | 1377.6019 | 1274.4587 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (103)   |
| Month fracti                           | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000    | 1.0000    | 1.0000    | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (103a)  |
| Space cooling kWh                      |        |        |        |        |        |           |           |           |                          |        |        |                |
| Space cooling                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 169.1984  | 269.5736  | 196.5640  | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (104)   |
| Space cooling                          |        |        |        |        |        |           |           |           |                          |        |        | 635.3360 (104) |
| Cooled fraction                        |        |        |        |        |        |           |           |           | FC = cooled area / (4) = |        |        | 1.0000 (105)   |
| Intermittency factor (Table 10b)       |        |        |        |        |        |           |           |           |                          |        |        |                |
| Intermittency factor                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500    | 0.2500    | 0.2500    | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (106)   |
| Space cooling kWh                      |        |        |        |        |        |           |           |           |                          |        |        |                |
| Space cooling                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 42.2996   | 67.3934   | 49.1410   | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling                          |        |        |        |        |        |           |           |           |                          |        |        | 158.8340 (107) |
| Space cooling per m2                   |        |        |        |        |        |           |           |           |                          |        |        | 0.9620 (108)   |
| Energy for space heating               |        |        |        |        |        |           |           |           |                          |        |        | 35.8343 (99)   |
| Energy for space cooling               |        |        |        |        |        |           |           |           |                          |        |        | 0.9620 (108)   |
| Total                                  |        |        |        |        |        |           |           |           |                          |        |        | 36.7963 (109)  |
| Target Fabric Energy Efficiency (TFEE) |        |        |        |        |        |           |           |           |                          |        |        | 42.3 (109)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Basement floor                                         | 46.3700 (1a)              | x 2.3800 (2a)                   | = 110.3606 (1a) - (3a)      |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)                   | = 123.8079 (1b) - (3b)      |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)                   | = 104.3546 (1c) - (3c)      |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)                   | = 76.1436 (1d) - (3d)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 414.6667 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0                           | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |                             |       | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |                             |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |                             |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             |       | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |                             |       | Yes                        |
| Measured/design AP50                                                      |                 |                      |                             |       | 5.0000                     |
| Infiltration rate                                                         |                 |                      |                             |       | 0.3465 (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) =        |       | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.3000 | 4.1000 | 4.1000 | 3.8000 | 3.9000 | 3.4000 | 3.4000 | 3.3000 | 3.4000 | 3.8000 | 3.7000 | 4.0000 (22)  |
| Wind factor     | 1.0750 | 1.0250 | 1.0250 | 0.9500 | 0.9750 | 0.8500 | 0.8500 | 0.8250 | 0.8500 | 0.9500 | 0.9250 | 1.0000 (22a) |
| Adj infilt rate | 0.3166 | 0.3019 | 0.3019 | 0.2798 | 0.2871 | 0.2503 | 0.2503 | 0.2430 | 0.2503 | 0.2798 | 0.2724 | 0.2945 (22b) |
| Effective ac    | 0.5501 | 0.5456 | 0.5456 | 0.5391 | 0.5412 | 0.5313 | 0.5313 | 0.5295 | 0.5313 | 0.5391 | 0.5371 | 0.5434 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Door -1                                                        |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| W-1.5 (Uw = 1.50)                                              |                         |                            | 22.8900                   | 1.4151                        | 32.3915      |                                | (27)          |
| Velux (Uw = 1.40)                                              |                         |                            | 1.8400                    | 1.3258                        | 2.4394       |                                | (27a)         |
| Basement floor                                                 |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                                  | 3.4500                  |                            | 3.4500                    | 0.1200                        | 0.4140       |                                | (29a)         |
| External wall                                                  | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                   | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                        | 29.5200                 |                            | 29.5200                   | 0.1100                        | 3.2472       |                                | (30)          |
| skelling                                                       | 15.0200                 | 1.8400                     | 13.1800                   | 0.1600                        | 2.1088       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 59.2578      |                                | (33)          |
| Party Wall                                                     |                         |                            | 117.3000                  | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.0986 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 67.3564 (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                     | 75.2773  | 74.6542  | 74.6542  | 73.7753  | 74.0608  | 72.7072  | 72.7072  | 72.4587  | 72.7072  | 73.7753  | 73.4971  | 74.3538 (38)  |
| Heat transfer coeff       | 142.6336 | 142.0106 | 142.0106 | 141.1316 | 141.4172 | 140.0635 | 140.0635 | 139.8151 | 140.0635 | 141.1316 | 140.8535 | 141.7102 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 141.0754 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8639 | 0.8601 | 0.8601 | 0.8548 | 0.8565 | 0.8483 | 0.8483 | 0.8468 | 0.8483 | 0.8548 | 0.8531 | 0.8583 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8544 (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                        | 2.9560 (42)   |
| Average daily hot water use (litres/day) | 104.4043 (43) |

|                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924 | 110.6686 | 114.8447 (44) |
| Energy conte        | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428 | 151.8852 | 164.9375 (45) |

Regs Region: England

Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.14r16

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF HEAT DEMAND 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                    |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------------|
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = | 1642.6862 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |                    |                |
|                                                                 | 25.5467  | 22.3433  | 23.0563  | 20.1010  | 19.2874  | 16.6436  | 15.4227  | 17.6978  | 17.9092  | 20.8714  | 22.7828  | 24.7406            | (46)           |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                    |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 250.0000           | (47)           |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 1.6000             | (48)           |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400             | (49)           |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.8640             | (55)           |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                    |                |
|                                                                 | 26.7840  | 24.1920  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840            | (56)           |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                    |                |
|                                                                 | 26.7840  | 24.1920  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840            | (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 |          |          |          |          |          |          |          |          |          |          |          |                    |                |
|                                                                 | 220.3578 | 194.1587 | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839           | (62)           |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | (63)           |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000             | (63)           |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                    |                |
|                                                                 | 220.3578 | 194.1587 | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839           | (64)           |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          | 2231.9422          | (64)           |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 2232               | (64)           |
| RHI water heating demand                                        |          |          |          |          |          |          |          |          |          |          |          |                    |                |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                    |                |
|                                                                 | 96.6657  | 85.6902  | 91.1453  | 83.3029  | 82.7909  | 75.6389  | 74.2242  | 79.2673  | 78.4443  | 86.3021  | 89.2474  | 94.8788            | (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                                                                               | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 79.0616   | 70.2218   | 57.1082   | 43.2346   | 32.3184   | 27.2845   | 29.4819   | 38.3217   | 51.4353   | 65.3089   | 76.2251   | 81.2589   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 502.2814  | 507.4935  | 494.3591  | 466.3977  | 431.1013  | 397.9278  | 375.7658  | 370.5537  | 383.6880  | 411.6495  | 446.9458  | 480.1194  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 129.9270  | 127.5152  | 122.5071  | 115.6985  | 111.2781  | 105.0540  | 99.7637   | 106.5420  | 108.9504  | 115.9974  | 123.9548  | 127.5253  | (72) |
| Total internal gains                                                                | 826.0811  | 820.0417  | 788.7856  | 740.1419  | 689.5090  | 645.0775  | 619.8225  | 630.2285  | 658.8848  | 707.7670  | 761.9369  | 803.7148  | (73) |

#### 6. Solar gains

| [Jan]       |           |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c |           | Access<br>factor<br>Table 6d |               | Gains<br>W    |
|-------------|-----------|-----------|-----------|-----------|------------|--------------------------------|-----------------------------------|-----------|------------------------------------|-----------|------------------------------|---------------|---------------|
| North       |           |           |           |           | 14.6700    | 12.7650                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       |               | 57.2301 (74)  |
| South       |           |           |           |           | 8.2200     | 54.2217                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       |               | 136.2125 (78) |
| North       |           |           |           |           | 0.9200     | 18.6626                        | 0.6300                            |           | 0.7000                             |           | 1.0000                       |               | 6.8146 (82)   |
| South       |           |           |           |           | 0.9200     | 54.1718                        | 0.6300                            |           | 0.7000                             |           | 1.0000                       |               | 19.7807 (82)  |
| -----       |           |           |           |           |            |                                |                                   |           |                                    |           |                              |               |               |
| Solar gains | 220.0378  | 333.4528  | 476.8526  | 653.5379  | 769.1998   | 835.8855                       | 786.2105                          | 694.1720  | 568.0806                           | 401.6718  | 260.6168                     | 188.8728 (83) |               |
| Total gains | 1046.1189 | 1153.4945 | 1265.6382 | 1393.6798 | 1458.7088  | 1480.9630                      | 1406.0330                         | 1324.4006 | 1226.9654                          | 1109.4388 | 1022.5537                    | 992.5876 (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                                                                         | 80.3876 | 80.7403 | 80.7403 | 81.2431 | 81.0790 | 81.8626 | 81.8626 | 82.0081 | 81.8626 | 81.2431 | 81.4035 | 80.9114                   |             |
| alpha                                                                       | 6.3592  | 6.3827  | 6.3827  | 6.4162  | 6.4053  | 6.4575  | 6.4575  | 6.4672  | 6.4575  | 6.4162  | 6.4269  | 6.3941                    |             |
| util living area                                                            | 0.9961  | 0.9917  | 0.9757  | 0.9101  | 0.7422  | 0.4892  | 0.3286  | 0.3586  | 0.6650  | 0.9322  | 0.9894  | 0.9970                    | (86)        |
| Tweekday                                                                    | 19.4020 | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808                   |             |
| Tweekend                                                                    | 20.6157 | 20.6729 | 20.7697 | 20.8857 | 20.9542 | 20.9716 | 20.9727 | 20.9727 | 20.9656 | 20.8832 | 20.7337 | 20.6045                   |             |
| 24 / 16                                                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         |             |
| 24 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         |             |
| 16 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         |             |
| MIT                                                                         | 20.4068 | 20.4940 | 20.6445 | 20.8215 | 20.9294 | 20.9564 | 20.9578 | 20.9578 | 20.9463 | 20.8198 | 20.5842 | 20.3895                   | (87)        |
| Th 2                                                                        | 20.1983 | 20.2016 | 20.2016 | 20.2061 | 20.2046 | 20.2117 | 20.2117 | 20.2130 | 20.2117 | 20.2061 | 20.2076 | 20.2031                   | (88)        |
| util rest of house                                                          | 0.9948  | 0.9890  | 0.9677  | 0.8829  | 0.6836  | 0.4164  | 0.2502  | 0.2758  | 0.5863  | 0.9051  | 0.9853  | 0.9960                    | (89)        |
| Tweekday                                                                    | 19.4020 | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808                   |             |
| Tweekend                                                                    | 19.4020 | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808                   |             |
| MIT 2                                                                       | 19.4020 | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808                   | (90)        |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = | 0.1599 (91) |
| MIT                                                                         | 19.5627 | 19.6868 | 19.8911 | 20.1280 | 20.2484 | 20.2782 | 20.2791 | 20.2802 | 20.2714 | 20.1274 | 19.8206 | 19.5421                   | (92)        |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000                    |             |
| adjusted MIT                                                                | 19.5627 | 19.6868 | 19.8911 | 20.1280 | 20.2484 | 20.2782 | 20.2791 | 20.2802 | 20.2714 | 20.1274 | 19.8206 | 19.5421                   | (93)        |

#### 8. Space heating requirement

|             |        |        |        |        |        |        |        |        |        |        |        |        |      |
|-------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| Utilisation | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
|             | 0.9934 | 0.9867 | 0.9638 | 0.8799 | 0.6870 | 0.4226 | 0.2569 | 0.2829 | 0.5925 | 0.9019 | 0.9827 | 0.9949 | (94) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF HEAT DEMAND 09 Jan 2014

|                          |           |           |           |           |           |          |          |          |          |           |           |           |       |
|--------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|
| Useful gains             | 1039.2005 | 1138.1491 | 1219.8067 | 1226.2469 | 1002.1238 | 625.8182 | 361.1948 | 374.6604 | 727.0084 | 1000.5758 | 1004.8865 | 987.5617  | (95)  |
| Ext temp.                | 5.1000    | 5.7000    | 7.4000    | 9.9000    | 12.9000   | 15.8000  | 17.7000  | 17.6000  | 15.0000  | 11.5000   | 8.0000    | 5.1000    | (96)  |
| Heat loss rate W         |           |           |           |           |           |          |          |          |          |           |           |           |       |
| Month fracti             | 2062.8677 | 1986.2682 | 1773.8733 | 1443.4998 | 1039.1833 | 627.2292 | 361.2363 | 374.7369 | 738.3310 | 1217.6055 | 1664.9738 | 2046.5957 | (97)  |
| Space heating kWh        | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000    | 1.0000    | 1.0000    | (97a) |
| Space heating            | 761.6084  | 569.9360  | 412.2255  | 156.4221  | 27.5723   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 161.4701  | 475.2629  | 787.9213  | (98)  |
| RHI space heating demand |           |           |           |           |           |          |          |          |          |           |           | 3352.4187 | (98)  |
|                          |           |           |           |           |           |          |          |          |          |           |           | 3352      | (98)  |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Basement floor                                         | 46.3700 (1a)              | x 2.3800 (2a)                   | = 110.3606 (1a) - (3a)      |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)                   | = 123.8079 (1b) - (3b)      |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)                   | = 104.3546 (1c) - (3c)      |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)                   | = 76.1436 (1d) - (3d)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 414.6667 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3239 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3460 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

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

| Element                                                        | Gross<br>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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Door -1                                                        |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| W-1.5 (Uw = 1.50)                                              |                         |                            | 22.8900                   | 1.4151                        | 32.3915      |                                | (27)          |
| Velux (Uw = 1.40)                                              |                         |                            | 1.8400                    | 1.3258                        | 2.4394       |                                | (27a)         |
| Basement floor                                                 |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                                  | 3.4500                  |                            | 3.4500                    | 0.1200                        | 0.4140       |                                | (29a)         |
| External wall                                                  | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                   | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                        | 29.5200                 |                            | 29.5200                   | 0.1100                        | 3.2472       |                                | (30)          |
| skelling                                                       | 15.0200                 | 1.8400                     | 13.1800                   | 0.1600                        | 2.1088       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 59.2578      |                                | (33)          |
| Party Wall                                                     |                         |                            | 117.3000                  | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.0986 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 67.3564 (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                     | 78.0662  | 77.6916  | 77.3245  | 75.5999  | 75.2773  | 73.7753  | 73.7753  | 73.4971  | 74.3538  | 75.2773  | 75.9300  | 76.6124 (38)  |
| Heat transfer coeff       | 145.4225 | 145.0480 | 144.6808 | 142.9563 | 142.6336 | 141.1316 | 141.1316 | 140.8535 | 141.7102 | 142.6336 | 143.2864 | 143.9687 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 142.9547 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8808 | 0.8785 | 0.8763 | 0.8658 | 0.8639 | 0.8548 | 0.8548 | 0.8531 | 0.8583 | 0.8639 | 0.8678 | 0.8720 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8658 (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                        |          |          |          |          |          |          |          |          |          |          |          | 2.9560 (42)   |
|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Average daily hot water use (litres/day) |          |          |          |          |          |          |          |          |          |          |          | 104.4043 (43) |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Daily hot water use                      | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924 | 110.6686 | 114.8447 (44) |
| Energy conte                             | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428 | 151.8852 | 164.9375 (45) |

Regs Region: England

Elmhurst Energy Systems  
SAP2012 Calculator (Design  
System) version 4.14r16

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

|                                                                 |                                   |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|-----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Energy content (annual)                                         | Total = Sum(45)m = 1642.6862 (45) |          |          |          |          |          |          |          |          |          |               |
| Distribution loss (46)m = 0.15 x (45)m                          |                                   |          |          |          |          |          |          |          |          |          |               |
| 25.5467                                                         | 22.3433                           | 23.0563  | 20.1010  | 19.2874  | 16.6436  | 15.4227  | 17.6978  | 17.9092  | 20.8714  | 22.7828  | 24.7406 (46)  |
| Water storage loss:                                             |                                   |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    | 250.0000 (47)                     |          |          |          |          |          |          |          |          |          |               |
| a) If manufacturer declared loss factor is known (kWh/day):     | 1.6000 (48)                       |          |          |          |          |          |          |          |          |          |               |
| Temperature factor from Table 2b                                | 0.5400 (49)                       |          |          |          |          |          |          |          |          |          |               |
| Enter (49) or (54) in (55)                                      | 0.8640 (55)                       |          |          |          |          |          |          |          |          |          |               |
| Total storage loss                                              |                                   |          |          |          |          |          |          |          |          |          |               |
| 26.7840                                                         | 24.1920                           | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840 (56)  |
| If cylinder contains dedicated solar storage                    |                                   |          |          |          |          |          |          |          |          |          |               |
| 26.7840                                                         | 24.1920                           | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840 (57)  |
| Primary loss                                                    | 23.2624                           | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |                                   |          |          |          |          |          |          |          |          |          |               |
| 220.3578                                                        | 194.1587                          | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839 (62) |
| Solar input                                                     | 0.0000                            | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Solar input (sum of months) = Sum(63)m =                        | 0.0000 (63)                       |          |          |          |          |          |          |          |          |          |               |
| Output from w/h                                                 |                                   |          |          |          |          |          |          |          |          |          |               |
| 220.3578                                                        | 194.1587                          | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839 (64) |
| Heat gains from water heating, kWh/month                        |                                   |          |          |          |          |          |          |          |          |          |               |
| 96.6657                                                         | 85.6902                           | 91.1453  | 83.3029  | 82.7909  | 75.6389  | 74.2242  | 79.2673  | 78.4443  | 86.3021  | 89.2474  | 94.8788 (65)  |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |                |
| (66)m                                                                               | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |                |
| 79.0616                                                                             | 70.2218   | 57.1082   | 43.2346   | 32.3184   | 27.2845   | 29.4819   | 38.3217   | 51.4353   | 65.3089   | 76.2251   | 81.2589 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |                |
| 502.2814                                                                            | 507.4935  | 494.3591  | 466.3977  | 431.1013  | 397.9278  | 375.7658  | 370.5537  | 383.6880  | 411.6495  | 446.9458  | 480.1194 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |                |
| 55.6918                                                                             | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |                |
| -118.2388                                                                           | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |                |
| 129.9270                                                                            | 127.5152  | 122.5071  | 115.6985  | 111.2781  | 105.0540  | 99.7637   | 106.5420  | 108.9504  | 115.9974  | 123.9548  | 127.5253 (72)  |
| Total internal gains                                                                | 826.0811  | 820.0417  | 788.7856  | 740.1419  | 689.5090  | 645.0775  | 619.8225  | 630.2285  | 658.8848  | 707.7670  | 761.9369 (73)  |

#### 6. Solar gains

| [Jan]       |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |           |          |               |
|-------------|-----------|-----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|-----------|----------|---------------|
| North       |           |           |           | 14.6700    | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       | 47.6731 (74)  |           |          |               |
| South       |           |           |           | 8.2200     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       | 117.4477 (78) |           |          |               |
| North       |           |           |           | 0.9200     | 15.6897                        | 0.6300                            | 0.7000                             | 1.0000                       | 5.7291 (82)   |           |          |               |
| South       |           |           |           | 0.9200     | 45.6416                        | 0.6300                            | 0.7000                             | 1.0000                       | 16.6659 (82)  |           |          |               |
| Solar gains | 187.5158  | 324.2638  | 463.7773  | 620.1197   | 744.6199                       | 763.5198                          | 725.8407                           | 627.7395                     | 516.3042      | 363.1051  | 225.3101 | 160.1100 (83) |
| Total gains | 1013.5969 | 1144.3055 | 1252.5628 | 1360.2617  | 1434.1289                      | 1408.5973                         | 1345.6632                          | 1257.9681                    | 1175.1890     | 1070.8721 | 987.2470 | 963.8249 (84) |

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

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 78.8459                   | 79.0495 | 79.2501 | 80.2061 | 80.3876 | 81.2431 | 81.2431 | 81.4035 | 80.9114 | 80.3876 | 80.0214 | 79.6421      |
| alpha                                                                       | 6.2564                    | 6.2700  | 6.2833  | 6.3471  | 6.3592  | 6.4162  | 6.4162  | 6.4269  | 6.3941  | 6.3592  | 6.3348  | 6.3095       |
| util living area                                                            | 0.9975                    | 0.9941  | 0.9839  | 0.9439  | 0.8282  | 0.6274  | 0.4597  | 0.5115  | 0.7740  | 0.9615  | 0.9941  | 0.9982 (86)  |
| Tweekday                                                                    | 19.2663                   | 19.4112 | 19.6280 | 19.8997 | 20.0758 | 20.1382 | 20.1436 | 20.1447 | 20.1171 | 19.9005 | 19.5411 | 19.2458      |
| Tweekend                                                                    | 20.5608                   | 20.6245 | 20.7208 | 20.8426 | 20.9320 | 20.9669 | 20.9719 | 20.9713 | 20.9526 | 20.8403 | 20.6785 | 20.5490      |
| 24 / 16                                                                     | 0                         | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0            |
| 24 / 9                                                                      | 0                         | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0            |
| 16 / 9                                                                      | 0                         | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0            |
| MIT                                                                         | 20.3222                   | 20.4191 | 20.5691 | 20.7543 | 20.8950 | 20.9492 | 20.9566 | 20.9557 | 20.9260 | 20.7535 | 20.4980 | 20.3039 (87) |
| Th 2                                                                        | 20.1839                   | 20.1858 | 20.1877 | 20.1966 | 20.1983 | 20.2061 | 20.2061 | 20.2076 | 20.2031 | 20.1983 | 20.1949 | 20.1914 (88) |
| util rest of house                                                          | 0.9967                    | 0.9923  | 0.9786  | 0.9260  | 0.7820  | 0.5555  | 0.3777  | 0.4253  | 0.7054  | 0.9454  | 0.9918  | 0.9976 (89)  |
| Tweekday                                                                    | 19.2663                   | 19.4112 | 19.6280 | 19.8997 | 20.0758 | 20.1382 | 20.1436 | 20.1447 | 20.1171 | 19.9005 | 19.5411 | 19.2458      |
| Tweekend                                                                    | 19.2663                   | 19.4112 | 19.6280 | 19.8997 | 20.0758 | 20.1382 | 20.1436 | 20.1447 | 20.1171 | 19.9005 | 19.5411 | 19.2458      |
| MIT 2                                                                       | 19.2663                   | 19.4112 | 19.6280 | 19.8997 | 20.0758 | 20.1382 | 20.1436 | 20.1447 | 20.1171 | 19.9005 | 19.5411 | 19.2458 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.4351                   | 19.5724 | 19.7785 | 20.0363 | 20.2068 | 20.2679 | 20.2736 | 20.2744 | 20.2464 | 20.0369 | 19.6941 | 19.4150 (91) |
| Temperature adjustment                                                      | 0.0000                    |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 19.4351                   | 19.5724 | 19.7785 | 20.0363 | 20.2068 | 20.2679 | 20.2736 | 20.2744 | 20.2464 | 20.0369 | 19.6941 | 19.4150 (93) |

#### 8. Space heating requirement

|              |           |           |           |           |           |          |          |          |          |           |          |               |
|--------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|----------|---------------|
| Utilisation  | 0.9958    | 0.9904    | 0.9752    | 0.9217    | 0.7825    | 0.5613   | 0.3848   | 0.4327   | 0.7094   | 0.9414    | 0.9900   | 0.9968 (94)   |
| Useful gains | 1009.3060 | 1133.3733 | 1221.5240 | 1253.7932 | 1122.2032 | 790.6206 | 517.7563 | 544.2731 | 833.7317 | 1008.0685 | 977.3314 | 960.7793 (95) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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|                      |           |           |           |           |           |          |          |          |          |           |              |                |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|--------------|----------------|
| 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     | 2200.9886 | 2128.1975 | 1921.1439 | 1592.0066 | 1213.3586 | 799.9213 | 518.4578 | 545.7178 | 871.0128 | 1346.0216 | 1804.5600    | 2190.4837 (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    | 886.6119  | 668.5219  | 520.5172  | 243.5136  | 67.8197   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 251.4371  | 595.6046     | 914.9000 (98)  |
| Space heating        |           |           |           |           |           |          |          |          |          |           |              | 4148.9260 (98) |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           | (98) / (4) = | 25.1283 (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 %)                      |          |          |          |          |          |          |          |          |          |          |          | 386.7589 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 100.0000 (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 1072.7421 (211) |
| Jan                                                                   | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 886.6119 | 668.5219 | 520.5172 | 243.5136 | 67.8197  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 251.4371 | 595.6046 | 914.9000 (98)   |
| Space heating efficiency (main heating system 1)                      | 386.7589 | 386.7589 | 386.7589 | 386.7589 | 386.7589 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 386.7589 | 386.7589 | 386.7589 (210)  |
| Space heating fuel (main heating system)                              | 229.2415 | 172.8523 | 134.5844 | 62.9626  | 17.5354  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 65.0113  | 153.9989 | 236.5556 (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                                             | 220.3578 | 194.1587 | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839 (64)   |
| Efficiency of water heater                                            | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 (216)  |
| (217)m                                                                | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 (217)  |
| Fuel for water heating, kWh/month                                     | 78.7091  | 69.3510  | 72.7788  | 65.1649  | 63.8041  | 56.9318  | 54.6013  | 60.0189  | 59.9455  | 67.5760  | 71.5508  | 76.7896 (219)   |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 797.2219 (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1072.7421 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (231)    |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 558.5009 (232)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 2428.4648 (238) |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          |                 |

10a. Fuel costs - using Table 12 prices

|                               |               |                  |                  |
|-------------------------------|---------------|------------------|------------------|
|                               | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
| Space heating - main system 1 | 1072.7421     | 13.1900          | 141.4947 (240)   |
| Space heating - secondary     | 0.0000        | 0.0000           | 0.0000 (242)     |
| Water heating (other fuel)    | 797.2219      | 13.1900          | 105.1536 (247)   |
| Pumps and fans for heating    | 0.0000        | 0.0000           | 0.0000 (249)     |
| Energy for lighting           | 558.5009      | 13.1900          | 73.6663 (250)    |
| Additional standing charges   |               |                  | 0.0000 (251)     |
| Total energy cost             |               |                  | 320.3145 (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] = | 0.6403 (257) |
| SAP value                        |                                  | 91.0679      |
| SAP rating (Section 12)          |                                  | 91 (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 | 1072.7421       | 0.5190                     | 556.7532 (261)        |
| Space heating - secondary     | 0.0000          | 0.5190                     | 0.0000 (263)          |
| Water heating (other fuel)    | 797.2219        | 0.5190                     | 413.7581 (264)        |
| Space and water heating       |                 |                            | 970.5113 (265)        |
| Pumps and fans                | 0.0000          | 0.0000                     | 0.0000 (267)          |
| Energy for lighting           | 558.5009        | 0.5190                     | 289.8619 (268)        |
| Total kg/year                 |                 |                            | 1260.3733 (272)       |
| CO2 emissions per m2          |                 |                            | 7.6300 (273)          |
| EI value                      |                 |                            | 91.9618               |
| EI rating                     |                 |                            | 92 (274)              |
| EI band                       |                 |                            | A                     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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Calculation of stars for heating and DHW

|                                    |                                                                     |
|------------------------------------|---------------------------------------------------------------------|
| Main heating energy efficiency     | $13.19 \times (1 + 0.29 \times 0.25) / 3.8676 = 3.658$ , stars = 5  |
| Main heating environmental impact  | $0.519 \times (1 + 0.29 \times 0.25) / 3.8676 = 0.1439$ , stars = 5 |
| Water heating energy efficiency    | $13.19 / 2.7997 = 4.711$ , stars = 4                                |
| Water heating environmental impact | $0.519 / 2.7997 = 0.1854$ , stars = 5                               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### 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                                         | 46.3700 (1a)              | x 2.3800 (2a)        | = 110.3606 (1a) - (3a)                         |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)        | = 123.8079 (1b) - (3b)                         |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)        | = 104.3546 (1c) - (3c)                         |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)        | = 76.1436 (1d) - (3d)                          |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 414.6667 (5) |
| Dwelling volume                                        |                           |                      |                                                |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.3000 | 4.1000 | 4.1000 | 3.8000 | 3.9000 | 3.4000 | 3.4000 | 3.3000 | 3.4000 | 3.8000 | 3.7000 | 4.0000 (22)  |
| Wind factor     | 1.0750 | 1.0250 | 1.0250 | 0.9500 | 0.9750 | 0.8500 | 0.8500 | 0.8250 | 0.8500 | 0.9500 | 0.9250 | 1.0000 (22a) |
| Adj infilt rate | 0.3166 | 0.3019 | 0.3019 | 0.2798 | 0.2871 | 0.2503 | 0.2503 | 0.2430 | 0.2503 | 0.2798 | 0.2724 | 0.2945 (22b) |
| Effective ac    | 0.5501 | 0.5456 | 0.5456 | 0.5391 | 0.5412 | 0.5313 | 0.5313 | 0.5295 | 0.5313 | 0.5391 | 0.5371 | 0.5434 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Door -1                                                        |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| W-1.5 (Uw = 1.50)                                              |                         |                            | 22.8900                   | 1.4151                        | 32.3915      |                                | (27)          |
| Velux (Uw = 1.40)                                              |                         |                            | 1.8400                    | 1.3258                        | 2.4394       |                                | (27a)         |
| Basement floor                                                 |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                                  | 3.4500                  |                            | 3.4500                    | 0.1200                        | 0.4140       |                                | (29a)         |
| External wall                                                  | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                   | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                        | 29.5200                 |                            | 29.5200                   | 0.1100                        | 3.2472       |                                | (30)          |
| skelling                                                       | 15.0200                 | 1.8400                     | 13.1800                   | 0.1600                        | 2.1088       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 59.2578      |                                | (33)          |
| Party Wall                                                     |                         |                            | 117.3000                  | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.0986 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 67.3564 (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                     | 75.2773  | 74.6542  | 74.6542  | 73.7753  | 74.0608  | 72.7072  | 72.7072  | 72.4587  | 72.7072  | 73.7753  | 73.4971  | 74.3538 (38)  |
| Heat transfer coeff       | 142.6336 | 142.0106 | 142.0106 | 141.1316 | 141.4172 | 140.0635 | 140.0635 | 139.8151 | 140.0635 | 141.1316 | 140.8535 | 141.7102 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 141.0754 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8639 | 0.8601 | 0.8601 | 0.8548 | 0.8565 | 0.8483 | 0.8483 | 0.8468 | 0.8483 | 0.8548 | 0.8531 | 0.8583 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8544 (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                        | 2.9560 (42)   |
| Average daily hot water use (litres/day) | 104.4043 (43) |

|                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924 | 110.6686 | 114.8447 (44) |
| Energy conte        | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428 | 151.8852 | 164.9375 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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

|                                                                 |                                                       |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|-------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Energy content (annual)                                         | Total = Sum(45)m = 1642.6862 (45)                     |          |          |          |          |          |          |          |          |          |               |
| Distribution loss (46)m = 0.15 x (45)m                          |                                                       |          |          |          |          |          |          |          |          |          |               |
| 25.5467                                                         | 22.3433                                               | 23.0563  | 20.1010  | 19.2874  | 16.6436  | 15.4227  | 17.6978  | 17.9092  | 20.8714  | 22.7828  | 24.7406 (46)  |
| Water storage loss:                                             |                                                       |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    | 250.0000 (47)                                         |          |          |          |          |          |          |          |          |          |               |
| a) If manufacturer declared loss factor is known (kWh/day):     | 1.6000 (48)                                           |          |          |          |          |          |          |          |          |          |               |
| Temperature factor from Table 2b                                | 0.5400 (49)                                           |          |          |          |          |          |          |          |          |          |               |
| Enter (49) or (54) in (55)                                      | 0.8640 (55)                                           |          |          |          |          |          |          |          |          |          |               |
| Total storage loss                                              |                                                       |          |          |          |          |          |          |          |          |          |               |
| 26.7840                                                         | 24.1920                                               | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840 (56)  |
| If cylinder contains dedicated solar storage                    |                                                       |          |          |          |          |          |          |          |          |          |               |
| 26.7840                                                         | 24.1920                                               | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840  | 26.7840  | 25.9200  | 26.7840  | 25.9200  | 26.7840 (57)  |
| Primary loss                                                    | 23.2624                                               | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |                                                       |          |          |          |          |          |          |          |          |          |               |
| 220.3578                                                        | 194.1587                                              | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839 (62) |
| Solar input                                                     | 0.0000                                                | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | Solar input (sum of months) = Sum(63)m = 0.0000 (63)  |          |          |          |          |          |          |          |          |          |               |
| 220.3578                                                        | 194.1587                                              | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839 (64) |
| Heat gains from water heating, kWh/month                        | Total per year (kWh/year) = Sum(64)m = 2231.9422 (64) |          |          |          |          |          |          |          |          |          |               |
| 96.6657                                                         | 85.6902                                               | 91.1453  | 83.3029  | 82.7909  | 75.6389  | 74.2242  | 79.2673  | 78.4443  | 86.3021  | 89.2474  | 94.8788 (65)  |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |                |
| (66)m                                                                               | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |                |
| 79.0616                                                                             | 70.2218   | 57.1082   | 43.2346   | 32.3184   | 27.2845   | 29.4819   | 38.3217   | 51.4353   | 65.3089   | 76.2251   | 81.2589 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |                |
| 502.2814                                                                            | 507.4935  | 494.3591  | 466.3977  | 431.1013  | 397.9278  | 375.7658  | 370.5537  | 383.6880  | 411.6495  | 446.9458  | 480.1194 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |                |
| 55.6918                                                                             | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |                |
| -118.2388                                                                           | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |                |
| 129.9270                                                                            | 127.5152  | 122.5071  | 115.6985  | 111.2781  | 105.0540  | 99.7637   | 106.5420  | 108.9504  | 115.9974  | 123.9548  | 127.5253 (72)  |
| Total internal gains                                                                | 826.0811  | 820.0417  | 788.7856  | 740.1419  | 689.5090  | 645.0775  | 619.8225  | 630.2285  | 658.8848  | 707.7670  | 761.9369 (73)  |

#### 6. Solar gains

| [Jan]       |           |           |           | Area<br>m2 |           | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |           | Access<br>factor<br>Table 6d | Gains<br>W    |               |
|-------------|-----------|-----------|-----------|------------|-----------|--------------------------------|-----------------------------------|------------------------------------|-----------|------------------------------|---------------|---------------|
| North       |           |           |           | 14.6700    |           | 12.7650                        | 0.6300                            | 0.7000                             |           | 0.7700                       | 57.2301 (74)  |               |
| South       |           |           |           | 8.2200     |           | 54.2217                        | 0.6300                            | 0.7000                             |           | 0.7700                       | 136.2125 (78) |               |
| North       |           |           |           | 0.9200     |           | 18.6626                        | 0.6300                            | 0.7000                             |           | 1.0000                       | 6.8146 (82)   |               |
| South       |           |           |           | 0.9200     |           | 54.1718                        | 0.6300                            | 0.7000                             |           | 1.0000                       | 19.7807 (82)  |               |
| Solar gains | 220.0378  | 333.4528  | 476.8526  | 653.5379   | 769.1998  | 835.8855                       | 786.2105                          | 694.1720                           | 568.0806  | 401.6718                     | 260.6168      | 188.8728 (83) |
| Total gains | 1046.1189 | 1153.4945 | 1265.6382 | 1393.6798  | 1458.7088 | 1480.9630                      | 1406.0330                         | 1324.4006                          | 1226.9654 | 1109.4388                    | 1022.5537     | 992.5876 (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                                                                         | 80.3876                               | 80.7403 | 80.7403 | 81.2431 | 81.0790 | 81.8626 | 81.8626 | 82.0081 | 81.8626 | 81.2431 | 81.4035 | 80.9114      |
| alpha                                                                       | 6.3592                                | 6.3827  | 6.3827  | 6.4162  | 6.4053  | 6.4575  | 6.4575  | 6.4672  | 6.4575  | 6.4162  | 6.4269  | 6.3941       |
| util living area                                                            | 0.9961                                | 0.9917  | 0.9757  | 0.9101  | 0.7422  | 0.4892  | 0.3286  | 0.3586  | 0.6650  | 0.9322  | 0.9894  | 0.9970 (86)  |
| Tweekday                                                                    | 19.4020                               | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808      |
| Tweekend                                                                    | 20.6157                               | 20.6729 | 20.7697 | 20.8857 | 20.9542 | 20.9716 | 20.9727 | 20.9727 | 20.9656 | 20.8832 | 20.7337 | 20.6045      |
| 24 / 16                                                                     | 0                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0            |
| 24 / 9                                                                      | 0                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0            |
| 16 / 9                                                                      | 0                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0            |
| MIT                                                                         | 20.4068                               | 20.4940 | 20.6445 | 20.8215 | 20.9294 | 20.9564 | 20.9578 | 20.9578 | 20.9463 | 20.8198 | 20.5842 | 20.3895 (87) |
| Th 2                                                                        | 20.1983                               | 20.2016 | 20.2016 | 20.2061 | 20.2046 | 20.2117 | 20.2117 | 20.2130 | 20.2117 | 20.2061 | 20.2076 | 20.2031 (88) |
| util rest of house                                                          | 0.9948                                | 0.9890  | 0.9677  | 0.8829  | 0.6836  | 0.4164  | 0.2502  | 0.2758  | 0.5863  | 0.9051  | 0.9853  | 0.9960 (89)  |
| Tweekday                                                                    | 19.4020                               | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808      |
| Tweekend                                                                    | 19.4020                               | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808      |
| MIT 2                                                                       | 19.4020                               | 19.5331 | 19.7478 | 19.9961 | 20.1187 | 20.1491 | 20.1499 | 20.1513 | 20.1429 | 19.9957 | 19.6753 | 19.3808 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = 0.1599 (91) |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.5627                               | 19.6868 | 19.8911 | 20.1280 | 20.2484 | 20.2782 | 20.2791 | 20.2802 | 20.2714 | 20.1274 | 19.8206 | 19.5421 (92) |
| Temperature adjustment                                                      | 0.0000                                |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 19.5627                               | 19.6868 | 19.8911 | 20.1280 | 20.2484 | 20.2782 | 20.2791 | 20.2802 | 20.2714 | 20.1274 | 19.8206 | 19.5421 (93) |

#### 8. Space heating requirement

|              |           |           |           |           |           |          |          |          |          |           |           |               |
|--------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|---------------|
| Utilisation  | 0.9934    | 0.9867    | 0.9638    | 0.8799    | 0.6870    | 0.4226   | 0.2569   | 0.2829   | 0.5925   | 0.9019    | 0.9827    | 0.9949 (94)   |
| Useful gains | 1039.2005 | 1138.1491 | 1219.8067 | 1226.2469 | 1002.1238 | 625.8182 | 361.1948 | 374.6604 | 727.0084 | 1000.5758 | 1004.8865 | 987.5617 (95) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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

|                      |           |           |           |           |           |          |          |          |          |           |              |                |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|--------------|----------------|
| Ext temp.            | 5.1000    | 5.7000    | 7.4000    | 9.9000    | 12.9000   | 15.8000  | 17.7000  | 17.6000  | 15.0000  | 11.5000   | 8.0000       | 5.1000 (96)    |
| Heat loss rate W     | 2062.8677 | 1986.2682 | 1773.8733 | 1443.4998 | 1039.1833 | 627.2292 | 361.2363 | 374.7369 | 738.3310 | 1217.6055 | 1664.9738    | 2046.5957 (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    | 761.6084  | 569.9360  | 412.2255  | 156.4221  | 27.5723   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 161.4701  | 475.2629     | 787.9213 (98)  |
| Space heating        |           |           |           |           |           |          |          |          |          |           |              | 3352.4187 (98) |
| Space heating per m2 |           |           |           |           |           |          |          |          |          |           | (98) / (4) = | 20.3042 (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 %)                      |          |          |          |          |          |          |          |          |          |          |          | 385.9786 (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 100.0000 (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 868.5503 (211)  |
| Jan                                                                   | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 761.6084 | 569.9360 | 412.2255 | 156.4221 | 27.5723  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 161.4701 | 475.2629 | 787.9213 (98)   |
| Space heating efficiency (main heating system 1)                      | 385.9786 | 385.9786 | 385.9786 | 385.9786 | 385.9786 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 385.9786 | 385.9786 | 385.9786 (210)  |
| Space heating fuel (main heating system)                              | 197.3188 | 147.6600 | 106.8001 | 40.5261  | 7.1435   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 41.8339  | 123.1319 | 204.1360 (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                                             | 220.3578 | 194.1587 | 203.7551 | 182.4390 | 178.6293 | 159.3892 | 152.8646 | 168.0318 | 167.8265 | 189.1892 | 200.3172 | 214.9839 (64)   |
| Efficiency of water heater                                            | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 (216)  |
| (217)m                                                                | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 (217)  |
| Fuel for water heating, kWh/month                                     | 78.7091  | 69.3510  | 72.7788  | 65.1649  | 63.8041  | 56.9318  | 54.6013  | 60.0189  | 59.9455  | 67.5760  | 71.5508  | 76.7896 (219)   |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 797.2219 (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 868.5503 (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (231)    |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 558.5009 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 2224.2730 (238) |

10a. Fuel costs - using BEDF prices (467)

|                               |          |            |                |
|-------------------------------|----------|------------|----------------|
|                               | Fuel     | Fuel price | Fuel cost      |
|                               | kWh/year | p/kWh      | £/year         |
| Space heating - main system 1 | 868.5503 | 18.7000    | 162.4189 (240) |
| Space heating - secondary     | 0.0000   | 0.0000     | 0.0000 (242)   |
| Water heating (other fuel)    | 797.2219 | 18.7000    | 149.0805 (247) |
| Pumps and fans for heating    | 0.0000   | 0.0000     | 0.0000 (249)   |
| Energy for lighting           | 558.5009 | 18.7000    | 104.4397 (250) |
| Additional standing charges   |          |            | 0.0000 (251)   |
| Total energy cost             |          |            | 415.9391 (255) |

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

|                               |          |                 |                 |
|-------------------------------|----------|-----------------|-----------------|
|                               | Energy   | Emission factor | Emissions       |
|                               | kWh/year | kg CO2/kWh      | kg CO2/year     |
| Space heating - main system 1 | 868.5503 | 0.5190          | 450.7776 (261)  |
| Space heating - secondary     | 0.0000   | 0.5190          | 0.0000 (263)    |
| Water heating (other fuel)    | 797.2219 | 0.5190          | 413.7581 (264)  |
| Space and water heating       |          |                 | 864.5358 (265)  |
| Pumps and fans                | 0.0000   | 0.0000          | 0.0000 (267)    |
| Energy for lighting           | 558.5009 | 0.5190          | 289.8619 (268)  |
| Total kg/year                 |          |                 | 1154.3977 (272) |

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

|                               |          |                       |                 |
|-------------------------------|----------|-----------------------|-----------------|
|                               | Energy   | Primary energy factor | Primary energy  |
|                               | kWh/year | kg CO2/kWh            | kWh/year        |
| Space heating - main system 1 | 868.5503 | 3.0700                | 2666.4495 (261) |
| Space heating - secondary     | 0.0000   | 3.0700                | 0.0000 (263)    |
| Water heating (other fuel)    | 797.2219 | 3.0700                | 2447.4711 (264) |
| Space and water heating       |          |                       | 5113.9206 (265) |
| Pumps and fans                | 0.0000   | 0.0000                | 0.0000 (267)    |
| Energy for lighting           | 558.5009 | 3.0700                | 1714.5977 (268) |
| Primary energy kWh/year       |          |                       | 6828.5182 (272) |
| Primary energy kWh/m2/year    |          |                       | 41.3574 (273)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 91  
Current environmental impact rating: A 92

|                         |                           |                  |                            |
|-------------------------|---------------------------|------------------|----------------------------|
| (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 + 1.1 | Cost change -£ 56          |
| U                       | Solar photovoltaic panels | SAP change + 6.4 | Cost change -£ 350         |
|                         |                           |                  | CO2 change -155 kg (13.4%) |
|                         |                           |                  | -971 kg (97.2%)            |

| Recommended measures      | Typical annual savings | Energy efficiency | Environmental impact |
|---------------------------|------------------------|-------------------|----------------------|
| Solar water heating       | £56                    | 0.94 kg/m²        | A 92 A 93            |
| Solar photovoltaic panels | £350                   | 5.88 kg/m²        | A 98 A 99            |
| Total Savings             | £406                   | 6.82 kg/m²        |                      |

Potential energy efficiency rating: A 98  
Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 467 TEST (29 Oct 2020)  
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              | £416       | £360       | £56        |
| Space heating            | £162       | £163       | -£0        |
| Water heating            | £149       | £93        | £56        |
| Lighting                 | £104       | £104       | £0         |
| Generated (PV)           | -£0        | -£350      | £350       |
| Total cost of fuels      | £416       | £10        | £406       |
| Total cost of uses       | £415       | £10        | £406       |
| Delivered energy         | 13 kWh/m²  | 0 kWh/m²   | 13 kWh/m²  |
| Carbon dioxide emissions | 1.2 tonnes | 0.0 tonnes | 1.1 tonnes |
| CO2 emissions per m²     | 7 kg/m²    | 0 kg/m²    | 7 kg/m²    |
| Primary energy           | 41 kWh/m²  | 1 kWh/m²   | 40 kWh/m²  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

### 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                                         | 46.3700 (1a)              | x 2.3800 (2a)        | = 110.3606 (1a) - (3a)                         |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)        | = 123.8079 (1b) - (3b)                         |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)        | = 104.3546 (1c) - (3c)                         |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)        | = 76.1436 (1d) - (3d)                          |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 414.6667 (5) |
| Dwelling volume                                        |                           |                      |                                                |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3755 | 0.3681 | 0.3608 | 0.3239 | 0.3166 | 0.2798 | 0.2798 | 0.2724 | 0.2945 | 0.3166 | 0.3313 | 0.3460 (22b) |
| Effective ac    | 0.5705 | 0.5678 | 0.5651 | 0.5525 | 0.5501 | 0.5391 | 0.5391 | 0.5371 | 0.5434 | 0.5501 | 0.5549 | 0.5599 (25)  |

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

| Element                                                        | Gross<br>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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Door -1                                                        |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| W-1.5 (Uw = 1.50)                                              |                         |                            | 22.8900                   | 1.4151                        | 32.3915      |                                | (27)          |
| Velux (Uw = 1.40)                                              |                         |                            | 1.8400                    | 1.3258                        | 2.4394       |                                | (27a)         |
| Basement floor                                                 |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                                  | 3.4500                  |                            | 3.4500                    | 0.1200                        | 0.4140       |                                | (29a)         |
| External wall                                                  | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                   | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                        | 29.5200                 |                            | 29.5200                   | 0.1100                        | 3.2472       |                                | (30)          |
| skelling                                                       | 15.0200                 | 1.8400                     | 13.1800                   | 0.1600                        | 2.1088       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 59.2578      |                                | (33)          |
| Party Wall                                                     |                         |                            | 117.3000                  | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.0986 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 67.3564 (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                     | 78.0662  | 77.6916  | 77.3245  | 75.5999  | 75.2773  | 73.7753  | 73.7753  | 73.4971  | 74.3538  | 75.2773  | 75.9300  | 76.6124 (38)  |
| Heat transfer coeff       | 145.4225 | 145.0480 | 144.6808 | 142.9563 | 142.6336 | 141.1316 | 141.1316 | 140.8535 | 141.7102 | 142.6336 | 143.2864 | 143.9687 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 142.9547 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8808 | 0.8785 | 0.8763 | 0.8658 | 0.8639 | 0.8548 | 0.8548 | 0.8531 | 0.8583 | 0.8639 | 0.8678 | 0.8720 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8658 (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                        | 2.9560 (42)   |
| Average daily hot water use (litres/day) | 104.4043 (43) |

|                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924 | 110.6686 | 114.8447 (44) |
| Energy conte        | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428 | 151.8852 | 164.9375 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



Property and Energy  
Services Ltd.

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

|                                                                 |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|----------|----------|------------------------------------------|----------------|
| Energy content (annual)                                         |          |          |          |          |           |           |           |           |          |          |          | Total = Sum(45)m =                       | 1642.6862 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
|                                                                 | 25.5467  | 22.3433  | 23.0563  | 20.1010  | 19.2874   | 16.6436   | 15.4227   | 17.6978   | 17.9092  | 20.8714  | 22.7828  | 24.7406                                  | (46)           |
| Water storage loss:                                             |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
| Store volume                                                    |          |          |          |          |           |           |           |           |          |          |          | 250.0000                                 | (47)           |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |           |           |           |           |          |          |          | 1.6000                                   | (48)           |
| Temperature factor from Table 2b                                |          |          |          |          |           |           |           |           |          |          |          | 0.5400                                   | (49)           |
| Enter (49) or (54) in (55)                                      |          |          |          |          |           |           |           |           |          |          |          | 0.8640                                   | (55)           |
| Total storage loss                                              |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
|                                                                 | 26.7840  | 24.1920  | 26.7840  | 25.9200  | 26.7840   | 25.9200   | 26.7840   | 26.7840   | 25.9200  | 26.7840  | 25.9200  | 26.7840                                  | (56)           |
| If cylinder contains dedicated solar storage                    |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
|                                                                 | 26.7840  | 24.1920  | 26.7840  | 25.9200  | 26.7840   | 25.9200   | 26.7840   | 26.7840   | 25.9200  | 26.7840  | 25.9200  | 26.7840                                  | (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 |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
|                                                                 | 220.3578 | 194.1587 | 202.3593 | 175.6854 | 165.8349  | 146.7825  | 139.8376  | 155.9353  | 162.4236 | 187.7934 | 200.3172 | 214.9839                                 | (62)           |
| Aperture area of solar collector                                |          |          |          |          |           |           |           |           |          |          |          | 3.0000                                   | (H1)           |
| Zero-loss collector efficiency                                  |          |          |          |          |           |           |           |           |          |          |          | 0.7000                                   | (H2)           |
| Collector heat loss coefficient                                 |          |          |          |          |           |           |           |           |          |          |          | 1.8000                                   | (H3)           |
| Collector 2nd order heat loss coefficient                       |          |          |          |          |           |           |           |           |          |          |          | 0.0050                                   | (H3a)          |
| Collector effective heat loss coefficient                       |          |          |          |          |           |           |           |           |          |          |          | 1.8063                                   | (H3b)          |
| Collector performance ratio                                     |          |          |          |          |           |           |           |           |          |          |          | 2.5804                                   | (H4)           |
| Annual solar radiation per m2                                   |          |          |          |          |           |           |           |           |          |          |          | 1079.5246                                | (H5)           |
| Overshading factor                                              |          |          |          |          |           |           |           |           |          |          |          | 0.8000                                   | (H6)           |
| Solar energy available                                          |          |          |          |          |           |           |           |           |          |          |          | 1813.6014                                | (H7)           |
| Adjustment factor for showers                                   |          |          |          |          |           |           |           |           |          |          |          | 1.0000                                   | (H7a)          |
| Solar-to-load ratio                                             |          |          |          |          |           |           |           |           |          |          |          | 1.1040                                   | (H8)           |
| Utilisation factor                                              |          |          |          |          |           |           |           |           |          |          |          | 0.5958                                   | (H9)           |
| Collector performance factor                                    |          |          |          |          |           |           |           |           |          |          |          | 0.8793                                   | (H10)          |
| Dedicated solar storage volume                                  |          |          |          |          |           |           |           |           |          |          |          | 75.0000                                  | (H11)          |
| Effective solar volume                                          |          |          |          |          |           |           |           |           |          |          |          | 75.0000                                  | (H13)          |
| Daily hot water demand                                          |          |          |          |          |           |           |           |           |          |          |          | 104.4043                                 | (H14)          |
| Volume ratio Veff/V                                             |          |          |          |          |           |           |           |           |          |          |          | 0.7184                                   | (H15)          |
| Solar storage volume factor                                     |          |          |          |          |           |           |           |           |          |          |          | 0.9338                                   | (H16)          |
| Solar input                                                     |          |          |          |          |           |           |           |           |          |          |          | -887.2067                                | (H17)          |
| Solar input                                                     | -25.7272 | -42.9313 | -73.1170 | -97.9912 | -121.0599 | -119.0211 | -117.4482 | -102.6151 | -80.3682 | -54.8820 | -30.5162 | -21.5293                                 | (63)           |
|                                                                 |          |          |          |          |           |           |           |           |          |          |          | Solar input (sum of months) = Sum(63)m = | -887.2067 (63) |
| Output from w/h                                                 |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
|                                                                 | 194.6306 | 151.2273 | 129.2423 | 77.6942  | 44.7751   | 27.7614   | 22.3894   | 53.3202   | 82.0554  | 132.9114 | 169.8010 | 193.4546                                 | (64)           |
|                                                                 |          |          |          |          |           |           |           |           |          |          |          | Total per year (kWh/year) = Sum(64)m =   | 1279.2630 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |           |           |           |           |          |          |          |                                          |                |
|                                                                 | 96.6657  | 85.6902  | 90.0287  | 77.9000  | 72.5555   | 65.5535   | 63.8026   | 69.5901   | 74.1220  | 85.1855  | 89.2474  | 94.8788                                  | (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                                                                               | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 79.0616   | 70.2218   | 57.1082   | 43.2346   | 32.3184   | 27.2845   | 29.4819   | 38.3217   | 51.4353   | 65.3089   | 76.2251   | 81.2589   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 502.2814  | 507.4935  | 494.3591  | 466.3977  | 431.1013  | 397.9278  | 375.7658  | 370.5537  | 383.6880  | 411.6495  | 446.9458  | 480.1194  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |           |      |
|                                                                                     | 129.9270  | 127.5152  | 121.0063  | 108.1945  | 97.5208   | 91.0465   | 85.7562   | 93.5351   | 102.9472  | 114.4966  | 123.9548  | 127.5253  | (72) |
| Total internal gains                                                                | 826.0811  | 820.0417  | 787.2848  | 732.6379  | 675.7517  | 631.0700  | 605.8151  | 617.2216  | 652.8816  | 706.2662  | 761.9369  | 803.7148  | (73) |

#### 6. Solar gains

| [Jan]       |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c |           | Access<br>factor<br>Table 6d | Gains<br>W    |               |
|-------------|-----------|-----------|-----------|------------|--------------------------------|-----------------------------------|-----------|------------------------------------|-----------|------------------------------|---------------|---------------|
| North       |           |           |           | 14.6700    | 10.6334                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       | 47.6731 (74)  |               |
| South       |           |           |           | 8.2200     | 46.7521                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       | 117.4477 (78) |               |
| North       |           |           |           | 0.9200     | 15.6897                        | 0.6300                            |           | 0.7000                             |           | 1.0000                       | 5.7291 (82)   |               |
| South       |           |           |           | 0.9200     | 45.6416                        | 0.6300                            |           | 0.7000                             |           | 1.0000                       | 16.6659 (82)  |               |
|             |           |           |           |            |                                |                                   |           |                                    |           |                              |               |               |
| Solar gains | 187.5158  | 324.2638  | 463.7773  | 620.1197   | 744.6199                       | 763.5198                          | 725.8407  | 627.7395                           | 516.3042  | 363.1051                     | 225.3101      | 160.1100 (83) |
| Total gains | 1013.5969 | 1144.3055 | 1251.0620 | 1352.7577  | 1420.3715                      | 1394.5898                         | 1331.6557 | 1244.9611                          | 1169.1858 | 1069.3713                    | 987.2470      | 963.8249 (84) |

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

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |      |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |         |      |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |      |
| tau                                                                         | 78.8459 | 79.0495 | 79.2501 | 80.2061 | 80.3876 | 81.2431 | 81.2431 | 81.4035 | 80.9114 | 80.3876 | 80.0214 | 79.6421 |      |
| alpha                                                                       | 6.2564  | 6.2700  | 6.2833  | 6.3471  | 6.3592  | 6.4162  | 6.4162  | 6.4269  | 6.3941  | 6.3592  | 6.3348  | 6.3095  |      |
| util living area                                                            | 0.9975  | 0.9941  | 0.9839  | 0.9452  | 0.8328  | 0.6330  | 0.4645  | 0.5167  | 0.7768  | 0.9617  | 0.9941  | 0.9982  | (86) |
| Tweekday                                                                    | 19.2663 | 19.4112 | 19.6272 | 19.8965 | 20.0736 | 20.1379 | 20.1435 | 20.1446 | 20.1165 | 19.8998 | 19.5411 | 19.2458 |      |
| Tweekend                                                                    | 20.5608 | 20.6245 | 20.7204 | 20.8411 | 20.9306 | 20.9666 | 20.9719 | 20.9712 | 20.9522 | 20.8400 | 20.6785 | 20.5490 |      |
| 24 / 16                                                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| 24 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| 16 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| MIT                                                                         | 20.3222 | 20.4191 | 20.5685 | 20.7519 | 20.8928 | 20.9487 | 20.9566 | 20.9556 | 20.9254 | 20.7530 | 20.4980 | 20.3039 | (87) |
| Th 2                                                                        | 20.1839 | 20.1858 | 20.1877 | 20.1966 | 20.1983 | 20.2061 | 20.2061 | 20.2076 | 20.2031 | 20.1983 | 20.1949 | 20.1914 | (88) |

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|                        |         |         |         |         |         |         |         |         |                           |         |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| util rest of house     | 0.9967  | 0.9923  | 0.9787  | 0.9275  | 0.7871  | 0.5608  | 0.3817  | 0.4297  | 0.7083                    | 0.9457  | 0.9918  | 0.9976 (89)  |
| Tweekday               | 19.2663 | 19.4112 | 19.6272 | 19.8965 | 20.0736 | 20.1379 | 20.1435 | 20.1446 | 20.1165                   | 19.8998 | 19.5411 | 19.2458      |
| Tweekend               | 19.2663 | 19.4112 | 19.6272 | 19.8965 | 20.0736 | 20.1379 | 20.1435 | 20.1446 | 20.1165                   | 19.8998 | 19.5411 | 19.2458      |
| MIT 2                  | 19.2663 | 19.4112 | 19.6272 | 19.8965 | 20.0736 | 20.1379 | 20.1435 | 20.1446 | 20.1165                   | 19.8998 | 19.5411 | 19.2458 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1599 (91)  |
| MIT                    | 19.4351 | 19.5724 | 19.7777 | 20.0333 | 20.2046 | 20.2676 | 20.2735 | 20.2743 | 20.2459                   | 20.0362 | 19.6941 | 19.4150 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT           | 19.4351 | 19.5724 | 19.7777 | 20.0333 | 20.2046 | 20.2676 | 20.2735 | 20.2743 | 20.2459                   | 20.0362 | 19.6941 | 19.4150 (93) |

#### 8. Space heating requirement

|                      |               |               |               |               |               |               |               |               |               |               |               |                    |
|----------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------------|
| Utilisation          | Jan<br>0.9958 | Feb<br>0.9904 | Mar<br>0.9754 | Apr<br>0.9233 | May<br>0.7875 | Jun<br>0.5665 | Jul<br>0.3888 | Aug<br>0.4371 | Sep<br>0.7123 | Oct<br>0.9417 | Nov<br>0.9900 | Dec<br>0.9968 (94) |
| Useful gains         | 1009.3060     | 1133.3733     | 1220.2273     | 1249.0060     | 1118.5276     | 790.0812      | 517.7080      | 544.1769      | 832.8160      | 1007.0010     | 977.3314      | 960.7793 (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     | 2200.9886     | 2128.1975     | 1921.0248     | 1591.5714     | 1213.0363     | 799.8750      | 518.4533      | 545.7091      | 870.9334      | 1345.9246     | 1804.5600     | 2190.4837 (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    | 886.6119      | 668.5219      | 521.3933      | 246.6470      | 70.3145       | 0.0000        | 0.0000        | 0.0000        | 0.0000        | 252.1592      | 595.6046      | 914.9000 (98)      |
| Space heating        |               |               |               |               |               |               |               |               |               |               |               | 4156.1524 (98)     |
| Space heating per m2 |               |               |               |               |               |               |               |               |               |               |               | 25.1720 (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 %)                      |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 386.7589 (206)       |
| Efficiency of secondary/supplementary heating system, %               |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 100.0000 (208)       |
| Space heating requirement                                             |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 1074.6106 (211)      |
| Space heating requirement                                             | Jan<br>886.6119 | Feb<br>668.5219 | Mar<br>521.3933 | Apr<br>246.6470 | May<br>70.3145 | Jun<br>0.0000 | Jul<br>0.0000 | Aug<br>0.0000 | Sep<br>0.0000 | Oct<br>252.1592 | Nov<br>595.6046 | Dec<br>914.9000 (98) |
| Space heating efficiency (main heating system 1)                      | 386.7589        | 386.7589        | 386.7589        | 386.7589        | 386.7589       | 0.0000        | 0.0000        | 0.0000        | 0.0000        | 386.7589        | 386.7589        | 386.7589 (210)       |
| Space heating fuel (main heating system)                              | 229.2415        | 172.8523        | 134.8109        | 63.7728         | 18.1805        | 0.0000        | 0.0000        | 0.0000        | 0.0000        | 65.1980         | 153.9989        | 236.5556 (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                                             | 194.6306        | 151.2273        | 129.2423        | 77.6942         | 44.7751        | 27.7614       | 22.3894       | 53.3202       | 82.0554       | 132.9114        | 169.8010        | 193.4546 (64)        |
| Efficiency of water heater (217)m                                     | 279.9650        | 279.9650        | 279.9650        | 279.9650        | 279.9650       | 279.9650      | 279.9650      | 279.9650      | 279.9650      | 279.9650        | 279.9650        | 279.9650 (216)       |
| Fuel for water heating, kWh/month                                     | 69.5196         | 54.0165         | 46.1637         | 27.7514         | 15.9931        | 9.9160        | 7.9972        | 19.0453       | 29.3092       | 47.4743         | 60.6508         | 69.0996 (219)        |
| Water heating fuel used                                               |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 456.9368 (219)       |
| Annual totals kWh/year                                                |                 |                 |                 |                 |                |               |               |               |               |                 |                 |                      |
| Space heating fuel - main system                                      |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 1074.6106 (211)      |
| Space heating fuel - secondary                                        |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 0.0000 (215)         |
| Electricity for pumps and fans:                                       |                 |                 |                 |                 |                |               |               |               |               |                 |                 |                      |
| pump for solar water heating                                          |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 50.0000 (230g)       |
| Total electricity for the above, kWh/year                             |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 50.0000 (231)        |
| Electricity for lighting (calculated in Appendix L)                   |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 558.5009 (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                                   |                 |                 |                 |                 |                |               |               |               |               |                 |                 | 412.8088 (238)       |

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

|                                       | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1         | 1074.6106        | 13.1900             | 141.7411 (240)      |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 456.9368         | 13.1900             | 60.2700 (247)       |
| Pumps and fans for heating            | 0.0000           | 0.0000              | 0.0000 (249)        |
| Pump for solar water heating          | 50.0000          | 13.1900             | 6.5950 (249)        |
| Energy for lighting                   | 558.5009         | 13.1900             | 73.6663 (250)       |
| Additional standing charges           |                  |                     | 0.0000 (251)        |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | -1727.2394       | 13.1900             | -227.8229 (252)     |
| Total energy cost                     |                  |                     | 54.4495 (255)       |

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

|                                  |              |
|----------------------------------|--------------|
| Energy cost deflator (Table 12): | 0.4200 (256) |
|----------------------------------|--------------|

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Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 0.1088 (257)  
 SAP value 98.4817  
 SAP rating (Section 12) 98 (258)  
 SAP band A

#### 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         | 1074.6106          | 0.5190                        | 557.7229 (261)           |
| Space heating - secondary             | 0.0000             | 0.5190                        | 0.0000 (263)             |
| Water heating (other fuel)            | 456.9368           | 0.5190                        | 237.1502 (264)           |
| Space and water heating               |                    |                               | 794.8731 (265)           |
| Pumps and fans                        | 50.0000            | 0.5190                        | 25.9500 (267)            |
| Energy for lighting                   | 558.5009           | 0.5190                        | 289.8619 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -1727.2394         | 0.5190                        | -896.4372 (269)          |
| Total kg/year                         |                    |                               | 214.2478 (272)           |
| CO2 emissions per m2                  |                    |                               | 1.3000 (273)             |
| EI value                              |                    |                               | 98.6336                  |
| EI rating                             |                    |                               | 99 (274)                 |
| EI band                               |                    |                               | A                        |

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### 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                                         | 46.3700 (1a)              | x 2.3800 (2a)                   | = 110.3606 (1a) - (3a)      |
| Ground floor                                           | 46.3700 (1b)              | x 2.6700 (2b)                   | = 123.8079 (1b) - (3b)      |
| First floor                                            | 39.8300 (1c)              | x 2.6200 (2c)                   | = 104.3546 (1c) - (3c)      |
| Second floor                                           | 32.5400 (1d)              | x 2.3400 (2d)                   | = 76.1436 (1d) - (3d)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 165.1100                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 414.6667 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.0965 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3465 (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) =        | 0.2945 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 4.3000 | 4.1000 | 4.1000 | 3.8000 | 3.9000 | 3.4000 | 3.4000 | 3.3000 | 3.4000 | 3.8000 | 3.7000 | 4.0000 (22)  |
| Wind factor     | 1.0750 | 1.0250 | 1.0250 | 0.9500 | 0.9750 | 0.8500 | 0.8500 | 0.8250 | 0.8500 | 0.9500 | 0.9250 | 1.0000 (22a) |
| Adj infilt rate | 0.3166 | 0.3019 | 0.3019 | 0.2798 | 0.2871 | 0.2503 | 0.2503 | 0.2430 | 0.2503 | 0.2798 | 0.2724 | 0.2945 (22b) |
| Effective ac    | 0.5501 | 0.5456 | 0.5456 | 0.5391 | 0.5412 | 0.5313 | 0.5313 | 0.5295 | 0.5313 | 0.5391 | 0.5371 | 0.5434 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| Door -1                                                        |                         |                            | 1.8000                    | 1.0000                        | 1.8000       |                                | (26)          |
| W-1.5 (Uw = 1.50)                                              |                         |                            | 22.8900                   | 1.4151                        | 32.3915      |                                | (27)          |
| Velux (Uw = 1.40)                                              |                         |                            | 1.8400                    | 1.3258                        | 2.4394       |                                | (27a)         |
| Basement floor                                                 |                         |                            | 46.3700                   | 0.1300                        | 6.0281       |                                | (28)          |
| Basement wall                                                  | 3.4500                  |                            | 3.4500                    | 0.1200                        | 0.4140       |                                | (29a)         |
| External wall                                                  | 76.6900                 | 20.9700                    | 55.7200                   | 0.1800                        | 10.0296      |                                | (29a)         |
| Dormer cheek                                                   | 8.1600                  | 3.7200                     | 4.4400                    | 0.1800                        | 0.7992       |                                | (29a)         |
| Ceiling                                                        | 29.5200                 |                            | 29.5200                   | 0.1100                        | 3.2472       |                                | (30)          |
| skelling                                                       | 15.0200                 | 1.8400                     | 13.1800                   | 0.1600                        | 2.1088       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 179.2100                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 59.2578      |                                | (33)          |
| Party Wall                                                     |                         |                            | 117.3000                  | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.0986 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 67.3564 (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                     | 75.2773  | 74.6542  | 74.6542  | 73.7753  | 74.0608  | 72.7072  | 72.7072  | 72.4587  | 72.7072  | 73.7753  | 73.4971  | 74.3538 (38)  |
| Heat transfer coeff       | 142.6336 | 142.0106 | 142.0106 | 141.1316 | 141.4172 | 140.0635 | 140.0635 | 139.8151 | 140.0635 | 141.1316 | 140.8535 | 141.7102 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 141.0754 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.8639 | 0.8601 | 0.8601 | 0.8548 | 0.8565 | 0.8483 | 0.8483 | 0.8468 | 0.8483 | 0.8548 | 0.8531 | 0.8583 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.8544 (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                        |          |          |          |          |          |          |          |          |          |          |          | 2.9560 (42)   |
|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Average daily hot water use (litres/day) |          |          |          |          |          |          |          |          |          |          |          | 104.4043 (43) |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Daily hot water use                      | 114.8447 | 110.6686 | 106.4924 | 102.3162 | 98.1400  | 93.9639  | 93.9639  | 98.1400  | 102.3162 | 106.4924 | 110.6686 | 114.8447 (44) |
| Energy conte                             | 170.3114 | 148.9555 | 153.7087 | 134.0070 | 128.5829 | 110.9572 | 102.8182 | 117.9854 | 119.3945 | 139.1428 | 151.8852 | 164.9375 (45) |

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|                                                                 |                                           |          |          |          |           |           |           |           |          |          |          |                 |
|-----------------------------------------------------------------|-------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|----------|----------|-----------------|
| Energy content (annual)                                         | Total = Sum (45)m =                       |          |          |          |           |           |           |           |          |          |          | 1642.6862 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |                                           |          |          |          |           |           |           |           |          |          |          |                 |
|                                                                 | 25.5467                                   | 22.3433  | 23.0563  | 20.1010  | 19.2874   | 16.6436   | 15.4227   | 17.6978   | 17.9092  | 20.8714  | 22.7828  | 24.7406 (46)    |
| Water storage loss:                                             |                                           |          |          |          |           |           |           |           |          |          |          |                 |
| Store volume                                                    |                                           |          |          |          |           |           |           |           |          |          |          | 250.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |                                           |          |          |          |           |           |           |           |          |          |          | 1.6000 (48)     |
| Temperature factor from Table 2b                                |                                           |          |          |          |           |           |           |           |          |          |          | 0.5400 (49)     |
| Enter (49) or (54) in (55)                                      |                                           |          |          |          |           |           |           |           |          |          |          | 0.8640 (55)     |
| Total storage loss                                              |                                           |          |          |          |           |           |           |           |          |          |          |                 |
|                                                                 | 26.7840                                   | 24.1920  | 26.7840  | 25.9200  | 26.7840   | 25.9200   | 26.7840   | 26.7840   | 25.9200  | 26.7840  | 25.9200  | 26.7840 (56)    |
| If cylinder contains dedicated solar storage                    |                                           |          |          |          |           |           |           |           |          |          |          |                 |
|                                                                 | 26.7840                                   | 24.1920  | 26.7840  | 25.9200  | 26.7840   | 25.9200   | 26.7840   | 26.7840   | 25.9200  | 26.7840  | 25.9200  | 26.7840 (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 |                                           |          |          |          |           |           |           |           |          |          |          |                 |
|                                                                 | 220.3578                                  | 194.1587 | 202.3593 | 175.6854 | 165.8349  | 146.7825  | 139.8376  | 155.9353  | 162.4236 | 187.7934 | 200.3172 | 214.9839 (62)   |
| Aperture area of solar collector                                |                                           |          |          |          |           |           |           |           |          |          |          | 3.0000 (H1)     |
| Zero-loss collector efficiency                                  |                                           |          |          |          |           |           |           |           |          |          |          | 0.7000 (H2)     |
| Collector heat loss coefficient                                 |                                           |          |          |          |           |           |           |           |          |          |          | 1.8000 (H3)     |
| Collector 2nd order heat loss coefficient                       |                                           |          |          |          |           |           |           |           |          |          |          | 0.0050 (H3a)    |
| Collector effective heat loss coefficient                       |                                           |          |          |          |           |           |           |           |          |          |          | 1.8063 (H3b)    |
| Collector performance ratio                                     |                                           |          |          |          |           |           |           |           |          |          |          | 2.5804 (H4)     |
| Annual solar radiation per m2                                   |                                           |          |          |          |           |           |           |           |          |          |          | 1169.5850 (H5)  |
| Overshading factor                                              |                                           |          |          |          |           |           |           |           |          |          |          | 0.8000 (H6)     |
| Solar energy available                                          |                                           |          |          |          |           |           |           |           |          |          |          | 1964.9028 (H7)  |
| Adjustment factor for showers                                   |                                           |          |          |          |           |           |           |           |          |          |          | 1.0000 (H7a)    |
| Solar-to-load ratio                                             |                                           |          |          |          |           |           |           |           |          |          |          | 1.1962 (H8)     |
| Utilisation factor                                              |                                           |          |          |          |           |           |           |           |          |          |          | 0.5666 (H9)     |
| Collector performance factor                                    |                                           |          |          |          |           |           |           |           |          |          |          | 0.8793 (H10)    |
| Dedicated solar storage volume                                  |                                           |          |          |          |           |           |           |           |          |          |          | 75.0000 (H11)   |
| Effective solar volume                                          |                                           |          |          |          |           |           |           |           |          |          |          | 75.0000 (H13)   |
| Daily hot water demand                                          |                                           |          |          |          |           |           |           |           |          |          |          | 104.4043 (H14)  |
| Volume ratio Veff/V                                             |                                           |          |          |          |           |           |           |           |          |          |          | 0.7184 (H15)    |
| Solar storage volume factor                                     |                                           |          |          |          |           |           |           |           |          |          |          | 0.9338 (H16)    |
| Solar input                                                     |                                           |          |          |          |           |           |           |           |          |          |          | -914.1109 (H17) |
| Solar input                                                     | -29.2109                                  | -42.6350 | -72.1742 | -98.3276 | -118.4670 | -123.2579 | -120.4059 | -107.7738 | -84.6120 | -58.5257 | -34.1420 | -24.5790 (63)   |
|                                                                 | Solar input (sum of months) = Sum (63)m = |          |          |          |           |           |           |           |          |          |          | -914.1109 (63)  |
| Output from w/h                                                 |                                           |          |          |          |           |           |           |           |          |          |          |                 |
|                                                                 | 191.1469                                  | 151.5236 | 130.1851 | 77.3577  | 47.3680   | 23.5246   | 19.4317   | 48.1615   | 77.8117  | 129.2678 | 166.1752 | 190.4050 (64)   |
|                                                                 | Total per year (kWh/year) = Sum (64)m =   |          |          |          |           |           |           |           |          |          |          | 1252.3588 (64)  |
| Heat gains from water heating, kWh/month                        |                                           |          |          |          |           |           |           |           |          |          |          |                 |
|                                                                 | 96.6657                                   | 85.6902  | 90.0287  | 77.9000  | 72.5555   | 65.5535   | 63.8026   | 69.5901   | 74.1220  | 85.1855  | 89.2474  | 94.8788 (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                                                                               | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | 177.3582  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 79.0616   | 70.2218   | 57.1082   | 43.2346   | 32.3184   | 27.2845   | 29.4819   | 38.3217   | 51.4353   | 65.3089   | 76.2251   | 81.2589   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 502.2814  | 507.4935  | 494.3591  | 466.3977  | 431.1013  | 397.9278  | 375.7658  | 370.5537  | 383.6880  | 411.6495  | 446.9458  | 480.1194  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | 55.6918   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | -118.2388 | (71) |
| Water heating gains (Table 5)                                                       | 129.9270  | 127.5152  | 121.0063  | 108.1945  | 97.5208   | 91.0465   | 85.7562   | 93.5351   | 102.9472  | 114.4966  | 123.9548  | 127.5253  | (72) |
| Total internal gains                                                                | 826.0811  | 820.0417  | 787.2848  | 732.6379  | 675.7517  | 631.0700  | 605.8151  | 617.2216  | 652.8816  | 706.2662  | 761.9369  | 803.7148  | (73) |

#### 6. Solar gains

| [Jan]       |           |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |           | FF<br>Specific data<br>or Table 6c |           | Access<br>factor<br>Table 6d |               | Gains<br>W    |  |
|-------------|-----------|-----------|-----------|-----------|------------|--------------------------------|-----------------------------------|-----------|------------------------------------|-----------|------------------------------|---------------|---------------|--|
| North       |           |           |           |           | 14.6700    | 12.7650                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       |               | 57.2301 (74)  |  |
| South       |           |           |           |           | 8.2200     | 54.2217                        | 0.6300                            |           | 0.7000                             |           | 0.7700                       |               | 136.2125 (78) |  |
| North       |           |           |           |           | 0.9200     | 18.6626                        | 0.6300                            |           | 0.7000                             |           | 1.0000                       |               | 6.8146 (82)   |  |
| South       |           |           |           |           | 0.9200     | 54.1718                        | 0.6300                            |           | 0.7000                             |           | 1.0000                       |               | 19.7807 (82)  |  |
| -----       |           |           |           |           |            |                                |                                   |           |                                    |           |                              |               |               |  |
| Solar gains | 220.0378  | 333.4528  | 476.8526  | 653.5379  | 769.1998   | 835.8855                       | 786.2105                          | 694.1720  | 568.0806                           | 401.6718  | 260.6168                     | 188.8728 (83) |               |  |
| Total gains | 1046.1189 | 1153.4945 | 1264.1374 | 1386.1758 | 1444.9515  | 1466.9555                      | 1392.0255                         | 1311.3936 | 1220.9622                          | 1107.9380 | 1022.5537                    | 992.5876 (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                                                                         | 80.3876 | 80.7403 | 80.7403 | 81.2431 | 81.0790 | 81.8626 | 81.8626 | 82.0081 | 81.8626 | 81.2431 | 81.4035 | 80.9114 |      |
| alpha                                                                       | 6.3592  | 6.3827  | 6.3827  | 6.4162  | 6.4053  | 6.4575  | 6.4575  | 6.4672  | 6.4575  | 6.4162  | 6.4269  | 6.3941  |      |
| util living area                                                            | 0.9961  | 0.9917  | 0.9758  | 0.9119  | 0.7475  | 0.4938  | 0.3319  | 0.3622  | 0.6678  | 0.9325  | 0.9894  | 0.9970  | (86) |
| Tweekday                                                                    | 19.4020 | 19.5331 | 19.7469 | 19.9936 | 20.1177 | 20.1490 | 20.1499 | 20.1513 | 20.1428 | 19.9951 | 19.6753 | 19.3808 |      |
| Tweekend                                                                    | 20.6157 | 20.6729 | 20.7693 | 20.8844 | 20.9535 | 20.9716 | 20.9727 | 20.9727 | 20.9654 | 20.8829 | 20.7337 | 20.6045 |      |
| 24 / 16                                                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| 24 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| 16 / 9                                                                      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       |      |
| MIT                                                                         | 20.4068 | 20.4940 | 20.6439 | 20.8195 | 20.9282 | 20.9564 | 20.9578 | 20.9578 | 20.9461 | 20.8193 | 20.5842 | 20.3895 | (87) |
| Th 2                                                                        | 20.1983 | 20.2016 | 20.2016 | 20.2061 | 20.2046 | 20.2117 | 20.2117 | 20.2130 | 20.2117 | 20.2061 | 20.2076 | 20.2031 | (88) |

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Property and Energy  
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|                        |         |         |         |         |         |         |         |         |                           |         |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| util rest of house     | 0.9948  | 0.9890  | 0.9678  | 0.8851  | 0.6890  | 0.4203  | 0.2527  | 0.2785  | 0.5890                    | 0.9055  | 0.9853  | 0.9960 (89)  |
| Tweekday               | 19.4020 | 19.5331 | 19.7469 | 19.9936 | 20.1177 | 20.1490 | 20.1499 | 20.1513 | 20.1428                   | 19.9951 | 19.6753 | 19.3808      |
| Tweekend               | 19.4020 | 19.5331 | 19.7469 | 19.9936 | 20.1177 | 20.1490 | 20.1499 | 20.1513 | 20.1428                   | 19.9951 | 19.6753 | 19.3808      |
| MIT 2                  | 19.4020 | 19.5331 | 19.7469 | 19.9936 | 20.1177 | 20.1490 | 20.1499 | 20.1513 | 20.1428                   | 19.9951 | 19.6753 | 19.3808 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1599 (91)  |
| MIT                    | 19.5627 | 19.6868 | 19.8904 | 20.1257 | 20.2473 | 20.2781 | 20.2791 | 20.2802 | 20.2712                   | 20.1269 | 19.8206 | 19.5421 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT           | 19.5627 | 19.6868 | 19.8904 | 20.1257 | 20.2473 | 20.2781 | 20.2791 | 20.2802 | 20.2712                   | 20.1269 | 19.8206 | 19.5421 (93) |

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
|----------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | 0.9934    | 0.9867    | 0.9640    | 0.8819    | 0.6923    | 0.4266   | 0.2595   | 0.2857   | 0.5952   | 0.9023       | 0.9827    | 0.9949 (94)    |
| Useful gains         | 1039.2005 | 1138.1491 | 1218.5944 | 1222.5267 | 1000.3653 | 625.7318 | 361.1919 | 374.6552 | 726.6966 | 999.7302     | 1004.8865 | 987.5617 (95)  |
| Ext temp.            | 5.1000    | 5.7000    | 7.4000    | 9.9000    | 12.9000   | 15.8000  | 17.7000  | 17.6000  | 15.0000  | 11.5000      | 8.0000    | 5.1000 (96)    |
| Heat loss rate W     | 2062.8677 | 1986.2682 | 1773.7635 | 1443.1685 | 1039.0324 | 627.2215 | 361.2360 | 374.7363 | 738.3041 | 1217.5298    | 1664.9738 | 2046.5957 (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    | 761.6084  | 569.9360  | 413.0458  | 158.8621  | 28.7684   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 162.0429     | 475.2629  | 787.9213 (98)  |
| Space heating        |           |           |           |           |           |          |          |          |          |              |           | 3357.4478 (98) |
| Space heating per m2 |           |           |           |           |           |          |          |          |          | (98) / (4) = |           | 20.3346 (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 %)                      |          |          |          |          |          |          |          |          |          |            |          |            | 385.9786 (206) |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |            |          |            | 100.0000 (208) |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |            |          |            | 869.8533 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct        | Nov      | Dec        |                |
| Space heating requirement                                             | 761.6084 | 569.9360 | 413.0458 | 158.8621 | 28.7684  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 162.0429   | 475.2629 | 787.9213   | (98)           |
| Space heating efficiency (main heating system 1)                      | 385.9786 | 385.9786 | 385.9786 | 385.9786 | 385.9786 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 385.9786   | 385.9786 | 385.9786   | (210)          |
| Space heating fuel (main heating system)                              | 197.3188 | 147.6600 | 107.0126 | 41.1583  | 7.4534   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 41.9824    | 123.1319 | 204.1360   | (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                                             | 191.1469 | 151.5236 | 130.1851 | 77.3577  | 47.3680  | 23.5246  | 19.4317  | 48.1615  | 77.8117  | 129.2678   | 166.1752 | 190.4050   | (64)           |
| Efficiency of water heater                                            | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650   | 279.9650 | 279.9650   | (216)          |
| (217)m                                                                | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650 | 279.9650   | 279.9650 | 279.9650   | (217)          |
| Fuel for water heating, kWh/month                                     | 68.2753  | 54.1223  | 46.5005  | 27.6312  | 16.9192  | 8.4027   | 6.9408   | 17.2027  | 27.7934  | 46.1728    | 59.3557  | 68.0103    | (219)          |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |            |          | 447.3269   | (219)          |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |            |          |            |                |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |            |          | 869.8533   | (211)          |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |            |          | 0.0000     | (215)          |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |            |          |            |                |
| pump for solar water heating                                          |          |          |          |          |          |          |          |          |          |            |          | 50.0000    | (230g)         |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |            |          | 50.0000    | (231)          |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |            |          | 558.5009   | (232)          |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |          |          |          |            |          |            |                |
| PV Unit 0 (0.80 * 2.50 * 1170 * 0.80) =                               |          |          |          |          |          |          |          |          |          | -1871.3360 |          | -1871.3360 | (233)          |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |            |          | 54.3451    | (238)          |

#### 10a. Fuel costs - using BEDF prices (467)

|                                       |               |                  |                  |  |
|---------------------------------------|---------------|------------------|------------------|--|
|                                       | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |  |
| Space heating - main system 1         | 869.8533      | 18.7000          | 162.6626 (240)   |  |
| Space heating - secondary             | 0.0000        | 0.0000           | 0.0000 (242)     |  |
| Water heating (other fuel)            | 447.3269      | 18.7000          | 83.6501 (247)    |  |
| Pumps and fans for heating            | 0.0000        | 0.0000           | 0.0000 (249)     |  |
| Pump for solar water heating          | 50.0000       | 18.7000          | 9.3500 (249)     |  |
| Energy for lighting                   | 558.5009      | 18.7000          | 104.4397 (250)   |  |
| Additional standing charges           |               |                  | 0.0000 (251)     |  |
| Energy saving/generation technologies |               |                  |                  |  |
| PV Unit                               | -1871.3360    | 18.7000          | -349.9398 (252)  |  |
| Total energy cost                     |               |                  | 10.1625 (255)    |  |

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

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

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|                                       | kWh/year   | kg CO2/kWh | kg CO2/year     |
|---------------------------------------|------------|------------|-----------------|
| Space heating - main system 1         | 869.8533   | 0.5190     | 451.4539 (261)  |
| Space heating - secondary             | 0.0000     | 0.5190     | 0.0000 (263)    |
| Water heating (other fuel)            | 447.3269   | 0.5190     | 232.1627 (264)  |
| Space and water heating               |            |            | 683.6165 (265)  |
| Pumps and fans                        | 50.0000    | 0.5190     | 25.9500 (267)   |
| Energy for lighting                   | 558.5009   | 0.5190     | 289.8619 (268)  |
| Energy saving/generation technologies |            |            |                 |
| PV Unit                               | -1871.3360 | 0.5190     | -971.2234 (269) |
| Total kg/year                         |            |            | 28.2051 (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         | 869.8533           | 3.0700                              | 2670.4496 (261)            |
| Space heating - secondary             | 0.0000             | 3.0700                              | 0.0000 (263)               |
| Water heating (other fuel)            | 447.3269           | 3.0700                              | 1373.2937 (264)            |
| Space and water heating               |                    |                                     | 4043.7432 (265)            |
| Pumps and fans                        | 50.0000            | 3.0700                              | 153.5000 (267)             |
| Energy for lighting                   | 558.5009           | 3.0700                              | 1714.5977 (268)            |
| Energy saving/generation technologies |                    |                                     |                            |
| PV Unit                               | -1871.3360         | 3.0700                              | -5745.0015 (269)           |
| Primary energy kWh/year               |                    |                                     | 166.8394 (272)             |
| Primary energy kWh/m2/year            |                    |                                     | 1.0105 (273)               |