

## Example SAP Calculation Printout

The following pages contain an example SAP calculation printout from Elmhurst's DesignSAP 10 software.

Key building characteristics from the printout that are required for B&NES and Cornwall Council's SAP Conversion Tool have been highlighted in yellow boxes, like the examples below:

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1. Overall dwelling characteristics
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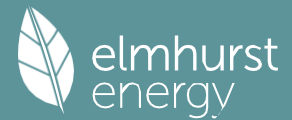
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|  | Area<br>(m <sup>2</sup> ) |   | Storey height<br>(m) |                                   | Volume<br>(m <sup>3</sup> ) |
|--|---------------------------|---|----------------------|-----------------------------------|-----------------------------|
| Ground floor   | 46.6000 (1b)              | x | 2.6500 (2b)          | =                                 | 123.4900 (1b) -             |
| First floor  | 46.6000 (1c)              | x | 2.4000 (2c)          | =                                 | 111.8400 (1c) -             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | <b>93.2000</b>            |   |                      |                                   | (4)                         |
| Dwelling volume  |                           |   |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | <b>235.3300</b> (5)         |

SAP 10 software is designed to provide compliance calculations only. It is not intended to represent real-world performance. Raw SAP 10 calculation results are not suitable for assessing performance against B&NES and Cornwall Council's net zero energy performance requirements for new buildings, as these are based on real-world performance.

The SAP Conversion Tool uses key building characteristics from a SAP 10 calculation to calculate more realistic energy performance, which can be used to assess performance against local net zero policy requirements. A comprehensive explanation of how this is achieved is available in the SAP Conversion Tool Methodology Report.

# Full SAP Calculation Printout



|                                    |                       |               |        |                |            |
|------------------------------------|-----------------------|---------------|--------|----------------|------------|
| Property Reference                 | SD - DPD Current - HP |               |        | Issued on Date | 25/09/2023 |
| Assessment Reference               | 001                   | Prop Type Ref |        |                |            |
| Property                           |                       |               |        |                |            |
| SAP Rating                         | 103 A                 | DER           | -0.21  | TER            | 10.80      |
| Environmental                      | 100 A                 | % DER < TER   | 101.94 |                |            |
| CO <sub>2</sub> Emissions (t/year) | -0.09                 | DFEE          | 36.16  | TFEE           | 36.50      |
| Compliance Check                   | See BREL              | % DFEE < TFEE | 0.92   |                |            |
| % DPER < TPER                      | 102.64                | DPER          | -1.49  | TPER           | 56.32      |
| Assessor Details                   | Ms. Caitlin Brown     |               |        | Assessor ID    | AX87-0001  |
| Client                             |                       |               |        |                |            |

## CAUTION! Results should not be taken from this section

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

### 1. Overall dwelling characteristics

|  | Area (m <sup>2</sup> ) | Storey height (m)               | Volume (m <sup>3</sup> ) |
|--|------------------------|---------------------------------|--------------------------|
| Ground floor   | 46.6000 (1b)           | x 2.4000 (2b)                   | = 111.8400 (1b)          |
| First floor  | 46.6000 (1c)           | x 2.6500 (2c)                   | = 123.4900 (1c)          |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.2000                |                                 | (4)                      |
| Dwelling volume  |                        | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 235.3300 (5)           |

### 2. Ventilation rate

|  | m <sup>3</sup> per hour |
|--|-------------------------|
| Number of open chimneys                            | 0 * 80 = 0.0000 (6a)    |
| Number of open flues                               | 0 * 20 = 0.0000 (6b)    |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 (6c)    |
| Number of flues attached to solid fuel boiler      | 0 * 20 = 0.0000 (6d)    |
| Number of flues attached to other heater           | 0 * 35 = 0.0000 (6e)    |
| Number of blocked chimneys                         | 0 * 20 = 0.0000 (6f)    |
| Number of intermittent extract fans                | 0 * 10 = 0.0000 (7a)    |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                       | 0 * 40 = 0.0000 (7c)    |

|  |                             |             |
|--|-----------------------------|-------------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) =              | 0.0000 (8)  |
| Pressure test  | Yes                         |             |
| Pressure Test Method   | Blower Door                 |             |
| Measured/design AP50   | 1.0000                      | (17)        |
| Infiltration rate  | 0.0500                      | (18)        |
| Number of sides sheltered  | 1                           | (19)        |
| Shelter factor   | (20) = 1 - [0.075 x (19)] = | 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor   | (21) = (18) x (20) =        | 0.0463 (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   | 0.0590 | 0.0578 | 0.0567 | 0.0509 | 0.0497 | 0.0439 | 0.0439 | 0.0428 | 0.0463 | 0.0497 | 0.0520 | 0.0543 (22b)  |
| Balanced mechanical ventilation with heat recovery  |        |        |        |        |        |        |        |        |        |        |        |               |
| If mechanical ventilation   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23b)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 79.2000 (23c) |
| Effective ac  | 0.1630 | 0.1618 | 0.1607 | 0.1549 | 0.1537 | 0.1479 | 0.1479 | 0.1468 | 0.1502 | 0.1537 | 0.1560 | 0.1583 (25)   |

### 3. Heat losses and heat loss parameter

| Element                    | Gross m <sup>2</sup> | Openings m <sup>2</sup> | NetArea m <sup>2</sup> | U-value W/m <sup>2</sup> K | A x U W/K | K-value kJ/m <sup>2</sup> K | A x K kJ/K |
|----------------------------|----------------------|-------------------------|------------------------|----------------------------|-----------|-----------------------------|------------|
| Entrance Door              |                      |                         | 2.1200                 | 1.0000                     | 2.1200    |                             | (26)       |
| Window FF 0.40 (Uw = 1.20) |                      |                         | 4.6000                 | 1.1450                     | 5.2672    |                             | (27)       |

# Full SAP Calculation Printout



|  |         |        |                      |  |        |  |         |  |         |  |           |  |       |
|--|---------|--------|----------------------|--|--------|--|---------|--|---------|--|-----------|--|-------|
| Window FF 0.48 (Uw = 1.20)                     |         |        | 5.2400               |  | 1.1450 |  | 6.0000  |  |         |  |           |  | (27)  |
| Window FF 0.52 (Uw = 1.20)                     |         |        | 3.0900               |  | 1.1450 |  | 3.5382  |  |         |  |           |  | (27)  |
| Window FF 0.53 (Uw = 1.20)                     |         |        | 0.7300               |  | 1.1450 |  | 0.8359  |  |         |  |           |  | (27)  |
| Window FF 0.70 (Uw = 1.20)                     |         |        | 0.3000               |  | 1.1450 |  | 0.3435  |  |         |  |           |  | (27)  |
| Ground Floor                                   |         |        | 46.6000              |  | 0.1300 |  | 6.0580  |  | 75.0000 |  | 3495.0000 |  | (28a) |
| Wall - NE                                      | 30.7600 | 9.0600 | 21.7000              |  | 0.2000 |  | 4.3400  |  | 70.0000 |  | 1519.0000 |  | (29a) |
| Wall - SW                                      | 30.7600 | 7.0200 | 23.7400              |  | 0.2000 |  | 4.7480  |  | 70.0000 |  | 1661.8000 |  | (29a) |
| Wall - NW                                      | 38.6300 |        | 38.6300              |  | 0.2000 |  | 7.7260  |  | 70.0000 |  | 2704.1000 |  | (29a) |
| Roof   | 46.6000 |        | 46.6000              |  | 0.1100 |  | 5.1260  |  | 9.0000  |  | 419.4000  |  | (30)  |
| Total net area of external elements Aum(A, m2) |         |        | 193.3500             |  |        |  |         |  |         |  |           |  | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |         |        | (26)...(30) + (32) = |  |        |  | 46.1027 |  |         |  |           |  | (33)  |
| Wall - SE                                      |         |        | 38.6300              |  | 0.0000 |  | 0.0000  |  | 45.0000 |  | 1738.3500 |  | (32)  |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 11537.6500 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 123.7945 (35)

List of Thermal Bridges

| K1 Element   | Length  | Psi-value | Total  |
|--|---------|-----------|--------|
| E3 Sill  | 10.6200 | 0.0500    | 0.5310 |
| E4 Jamb  | 27.1800 | 0.0500    | 1.3590 |
| E2 Other lintels (including other steel lintels)   | 10.6200 | 0.0500    | 0.5310 |
| E5 Ground floor (normal)                           | 19.8300 | 0.1600    | 3.1728 |
| E10 Eaves (insulation at ceiling level)            | 12.1800 | 0.0800    | 0.9744 |
| E12 Gable (insulation at ceiling level)            | 7.6500  | 0.1200    | 0.9180 |
| E16 Corner (normal)                                | 10.1000 | 0.0500    | 0.5050 |
| E18 Party wall between dwellings                   | 10.1000 | 0.0400    | 0.4040 |
| P1 Party wall - Ground floor                       | 7.6500  | 0.1500    | 1.1475 |
| P4 Party wall - Roof (insulation at ceiling level) | 7.6500  | 0.1100    | 0.8415 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.3842 (36)

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 56.4869 (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          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Heat transfer coeff       | 12.6560 | 12.5662 | 12.4764 | 12.0274 | 11.9376 | 11.4887 | 11.4887 | 11.3989 | 11.6682 | 11.9376 | 12.1172 | 12.2968 (38) |
| Average = Sum(39)m / 12 = | 69.1429 | 69.0531 | 68.9633 | 68.5144 | 68.4246 | 67.9756 | 67.9756 | 67.8858 | 68.1552 | 68.4246 | 68.6041 | 68.7837 (39) |

| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP (average) | 0.7419 | 0.7409 | 0.7399 | 0.7351 | 0.7342 | 0.7294 | 0.7294 | 0.7284 | 0.7313 | 0.7342 | 0.7361 | 0.7380 (40) |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31          |

4. Water heating energy requirements (kWh/year)

| Assumed occupancy                        | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec           |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------|
| Hot water usage for mixer showers        | 68.9372 | 67.9012 | 66.3916 | 63.5031 | 61.3715 | 58.9944 | 57.6433 | 59.1415 | 60.7838 | 63.3361 | 66.2866 | 68.6731 (42a) |
| Hot water usage for baths                | 29.7685 | 29.3264 | 28.7038 | 27.5559 | 26.6963 | 25.7432 | 25.2284 | 25.8466 | 26.5198 | 27.5396 | 28.7112 | 29.6678 (42b) |
| Hot water usage for other uses           | 41.9431 | 40.4179 | 38.8927 | 37.3675 | 35.8423 | 34.3171 | 34.3171 | 35.8423 | 37.3675 | 38.8927 | 40.4179 | 41.9431 (42c) |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |         | 129.2880 (43) |

| Daily hot water use                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Energy conte                           | 140.6488 | 137.6455 | 133.9881 | 128.4265 | 123.9102 | 119.0548 | 117.1888 | 120.8304 | 124.6711 | 129.7685 | 135.4157 | 140.2840 (44) |
| Energy content (annual)                | 222.7533 | 196.0054 | 205.9347 | 175.8095 | 166.8069 | 146.3917 | 141.7297 | 149.6133 | 153.7319 | 176.0946 | 192.9245 | 219.6509 (45) |
| Distribution loss (46)m = 0.15 x (45)m | 33.4130  | 29.4008  | 30.8902  | 26.3714  | 25.0210  | 21.9588  | 21.2595  | 22.4420  | 23.0598  | 26.4142  | 28.9387  | 32.9476 (46)  |

Water storage loss:  
 Store volume 200.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day): 1.4000 (48)

Temperature factor from Table 2b 0.5400 (49)  
 Enter (49) or (54) in (55) 0.7560 (55)

Total storage loss 23.4360 21.1680 23.4360 22.6800 23.4360 22.6800 23.4360 23.4360 22.6800 23.4360 22.6800 23.4360 23.4360 (56)

If cylinder contains dedicated solar storage 23.4360 21.1680 23.4360 22.6800 23.4360 22.6800 23.4360 23.4360 22.6800 23.4360 22.6800 23.4360 23.4360 (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 23.2624 (59)

Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)

Total heat required for water heating calculated for each month 269.4517 238.1846 252.6331 221.0015 213.5053 191.5837 188.4281 196.3117 198.9239 222.7930 238.1165 266.3493 (62)

WVHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63a)

PV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)

Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63c)

FGHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63d)

Output from w/h 269.4517 238.1846 252.6331 221.0015 213.5053 191.5837 188.4281 196.3117 198.9239 222.7930 238.1165 266.3493 (64)

Total per year (kWh/year) = Sum(64)m = 2697.2824 (64)

Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month 111.4242 98.9151 105.8320 94.6103 92.8220 84.8288 84.4838 87.1051 87.2695 95.9102 100.3010 110.3926 (65)

# Full SAP Calculation Printout



## 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   | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 142.4430  | 157.7047  | 142.4430  | 147.1911  | 142.4430  | 147.1911  | 142.4430  | 142.4430  | 147.1911  | 142.4430  | 147.1911  | 142.4430 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 244.8433  | 247.3840  | 240.9815  | 227.3513  | 210.1457  | 193.9748  | 183.1717  | 180.6310  | 187.0335  | 200.6636  | 217.8693  | 234.0402 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352 (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)                                 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 (71) |
| Water heating gains (Table 5)   | 149.7637  | 147.1952  | 142.2473  | 131.4031  | 124.7608  | 117.8178  | 113.5535  | 117.0768  | 121.2076  | 128.9115  | 139.3069  | 148.3772 (72)  |
| Total internal gains  | 600.0555  | 615.2894  | 588.6774  | 568.9511  | 540.3550  | 521.9893  | 502.1738  | 503.1563  | 518.4377  | 535.0237  | 567.3729  | 587.8659 (73)  |

## 6. Solar gains

| [Jan]       | Area     |          | Solar flux |          | g             |          | FF            |          | Access   |          | Gains    |               |
|-------------|----------|----------|------------|----------|---------------|----------|---------------|----------|----------|----------|----------|---------------|
|             | m2       |          | Table 6a   |          | Specific data |          | Specific data |          | factor   |          | W        |               |
|             |          |          | W/m2       |          | or Table 6b   |          | or Table 6c   |          | Table 6d |          |          |               |
| Northeast   | 4.6000   |          | 11.2829    |          | 0.6200        |          | 0.4000        |          | 0.7700   |          | 8.9200   | (75)          |
| Northeast   | 1.3100   |          | 11.2829    |          | 0.6200        |          | 0.4800        |          | 0.7700   |          | 3.0483   | (75)          |
| Southwest   | 3.9300   |          | 36.7938    |          | 0.6200        |          | 0.4800        |          | 0.7700   |          | 29.8218  | (79)          |
| Southwest   | 3.0900   |          | 36.7938    |          | 0.6200        |          | 0.5200        |          | 0.7700   |          | 25.4016  | (79)          |
| Northeast   | 0.7300   |          | 11.2829    |          | 0.6200        |          | 0.5300        |          | 0.7700   |          | 1.8756   | (75)          |
| Northeast   | 0.3000   |          | 11.2829    |          | 0.6200        |          | 0.7000        |          | 0.7700   |          | 1.0180   | (75)          |
| Solar gains | 70.0854  | 124.3179 | 183.2096   | 248.9839 | 298.9435      | 305.6058 | 290.9644      | 252.3433 | 205.7750 | 140.9332 | 84.8452  | 59.3968 (83)  |
| Total gains | 670.1410 | 739.6074 | 771.8870   | 817.9350 | 839.2986      | 827.5951 | 793.1382      | 755.4996 | 724.2127 | 675.9569 | 652.2180 | 647.2627 (84) |

## 7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |              |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| 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   | 46.3519 | 46.4121 | 46.4726 | 46.7771 | 46.8385 | 47.1478 | 47.1478 | 47.2102 | 47.0236                   | 46.8385 | 46.7159 | 46.5939      |
| alpha   | 4.0901  | 4.0941  | 4.0982  | 4.1185  | 4.1226  | 4.1432  | 4.1432  | 4.1473  | 4.1349                    | 4.1226  | 4.1144  | 4.1063       |
| util living area  | 0.9516  | 0.9279  | 0.8923  | 0.8100  | 0.6809  | 0.5076  | 0.3729  | 0.4071  | 0.6065                    | 0.8249  | 0.9227  | 0.9571 (86)  |
| Living  | 19.8708 | 20.0703 | 20.3197 | 20.6355 | 20.8579 | 20.9673 | 20.9928 | 20.9896 | 20.9320                   | 20.6627 | 20.2301 | 19.8275      |
| Non living  | 19.5509 | 19.7478 | 19.9932 | 20.3008 | 20.5103 | 20.6098 | 20.6305 | 20.6286 | 20.5795                   | 20.3300 | 19.9087 | 19.5097      |
| 24 / 16   | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 24 / 9  | 3       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 16 / 9  | 28      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 10           |
| MIT   | 20.4224 | 20.0703 | 20.3197 | 20.6355 | 20.8579 | 20.9673 | 20.9928 | 20.9896 | 20.9320                   | 20.6627 | 20.2301 | 19.9915 (87) |
| Th 2  | 20.6291 | 20.6295 | 20.6300 | 20.6324 | 20.6329 | 20.6353 | 20.6353 | 20.6358 | 20.6344                   | 20.6329 | 20.6320 | 20.6310 (88) |
| util rest of house  | 0.9482  | 0.9230  | 0.8849  | 0.7976  | 0.6616  | 0.4817  | 0.3431  | 0.3763  | 0.5804                    | 0.8110  | 0.9167  | 0.9540 (89)  |
| MIT 2   | 20.0775 | 19.7478 | 19.9932 | 20.3008 | 20.5103 | 20.6098 | 20.6305 | 20.6286 | 20.5795                   | 20.3300 | 19.9087 | 19.6665 (90) |
| Living area fraction  |         |         |         |         |         |         |         |         | flA = Living area / (4) = |         |         | 0.3433 (91)  |
| MIT   | 20.1959 | 19.8585 | 20.1053 | 20.4157 | 20.6297 | 20.7326 | 20.7549 | 20.7526 | 20.7005                   | 20.4442 | 20.0190 | 19.7781 (92) |
| Temperature adjustment  |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT  | 20.1959 | 19.8585 | 20.1053 | 20.4157 | 20.6297 | 20.7326 | 20.7549 | 20.7526 | 20.7005                   | 20.4442 | 20.0190 | 19.7781 (93) |

## 8. Space heating requirement

|  | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation  | 0.9439    | 0.9115    | 0.8736   | 0.7899   | 0.6614   | 0.4887   | 0.3529   | 0.3862   | 0.5852   | 0.8034        | 0.9055   | 0.9459 (94)    |
| Useful gains   | 632.5402  | 674.1757  | 674.3096 | 646.0627 | 555.1172 | 404.4269 | 279.8945 | 291.7827 | 423.8056 | 543.0427      | 590.6058 | 612.2515 (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   | 1099.0911 | 1032.9335 | 938.2654 | 788.9919 | 611.0102 | 416.8651 | 282.4291 | 295.4778 | 449.8589 | 673.5859      | 886.3004 | 1071.5189 (97) |
| Space heating kWh  | 347.1139  | 241.0853  | 196.3831 | 102.9090 | 41.5844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 97.1241       | 212.9001 | 341.6949 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |          |          |          |          |          |          |          |               |          | 1580.7950      |
| Solar heating kWh  | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000   | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         |           |           |          |          |          |          |          |          |          |               |          | 0.0000         |
| Space heating kWh  | 347.1139  | 241.0853  | 196.3831 | 102.9090 | 41.5844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 97.1241       | 212.9001 | 341.6949 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |          |          |          |          |          |          |          |               |          | 1580.7950      |
| Space heating per m2   |           |           |          |          |          |          |          |          |          | (98c) / (4) = |          | 16.9613 (99)   |

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

# Full SAP Calculation Printout

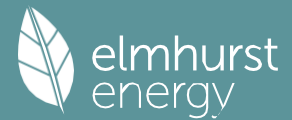


|  |          |           |           |           |           |           |           |           |           |           |          |          |                  |
|--|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------------|
| 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 %)   |          |           |           |           |           |           |           |           |           |           |          |          | 311.0195 (206)   |
| Efficiency of main space heating system 2 (in %)   |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (207)     |
| Efficiency of secondary/supplementary heating system, %  |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (208)     |
|  | Jan      | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov      | Dec      |                  |
| Space heating requirement  | 347.1139 | 241.0853  | 196.3831  | 102.9090  | 41.5844   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 97.1241   | 212.9001 | 341.6949 | (98)             |
| Space heating efficiency (main heating system 1)   | 311.0195 | 311.0195  | 311.0195  | 311.0195  | 311.0195  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 311.0195  | 311.0195 | 311.0195 | (210)            |
| Space heating fuel (main heating system)   | 111.6052 | 77.5145   | 63.1417   | 33.0876   | 13.3704   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 31.2277   | 68.4523  | 109.8629 | (211)            |
| Space heating efficiency (main heating system 2)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (212)            |
| Space heating fuel (main heating system 2)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (213)            |
| Space heating fuel (secondary)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (215)            |
| Water heating  |          |           |           |           |           |           |           |           |           |           |          |          |                  |
| Water heating requirement  | 269.4517 | 238.1846  | 252.6331  | 221.0015  | 213.5053  | 191.5837  | 188.4281  | 196.3117  | 198.9239  | 222.7930  | 238.1165 | 266.3493 | (64)             |
| Efficiency of water heater   | 188.5207 | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207 | 188.5207 | (216)            |
| Fuel for water heating, kWh/month  | 142.9295 | 126.3440  | 134.0081  | 117.2293  | 113.2530  | 101.6247  | 99.9509   | 104.1327  | 105.5183  | 118.1796  | 126.3078 | 141.2838 | (219)            |
| Space cooling fuel 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   | (221)            |
| Pumps and Fa   | 16.0935  | 14.5360   | 16.0935   | 15.5743   | 16.0935   | 15.5743   | 16.0935   | 16.0935   | 15.5743   | 16.0935   | 15.5743  | 16.0935  | (231)            |
| Lighting   | 35.0150  | 28.0903   | 25.2922   | 18.5302   | 14.3132   | 11.6940   | 13.0570   | 16.9720   | 22.0449   | 28.9241   | 32.6698  | 35.9881  | (232)            |
| Electricity generated by PVs (Appendix M) (negative quantity)  | -73.3578 | -123.8931 | -212.5738 | -279.5061 | -332.5423 | -319.4297 | -314.8581 | -281.8608 | -226.0268 | -157.5707 | -87.1773 | -61.0151 | (233a)           |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (234a)           |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (235a)           |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (235c)           |
| Electricity generated by PVs (Appendix M) (negative quantity)  | -0.6991  | -3.0627   | -11.1534  | -28.8454  | -54.0320  | -62.5046  | -61.2709  | -43.3494  | -22.9847  | -6.9087   | -1.3654  | -0.4659  | (233b)           |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (234b)           |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (235b)           |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | (235d)           |
| Annual totals kWh/year   |          |           |           |           |           |           |           |           |           |           |          |          |                  |
| Space heating fuel - main system 1   |          |           |           |           |           |           |           |           |           |           |          |          | 508.2623 (211)   |
| Space heating fuel - main system 2   |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (213)     |
| Space heating fuel - secondary   |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (215)     |
| Efficiency of water heater   |          |           |           |           |           |           |           |           |           |           |          |          | 188.5207 (216)   |
| Water heating fuel used  |          |           |           |           |           |           |           |           |           |           |          |          | 1430.7617 (219)  |
| Space cooling fuel   |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (221)     |
| Electricity for pumps and fans:  |          |           |           |           |           |           |           |           |           |           |          |          |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.1000, SFP = 0.6600)                          |          |           |           |           |           |           |           |           |           |           |          |          |                  |
| mechanical ventilation fans (SFP = 0.6600)   |          |           |           |           |           |           |           |           |           |           |          |          | 189.4877 (230a)  |
| Total electricity for the above, kWh/year  |          |           |           |           |           |           |           |           |           |           |          |          | 189.4877 (231)   |
| Electricity for lighting (calculated in Appendix L)  |          |           |           |           |           |           |           |           |           |           |          |          | 282.5909 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)  |          |           |           |           |           |           |           |           |           |           |          |          |                  |
| PV generation  |          |           |           |           |           |           |           |           |           |           |          |          | -2766.4539 (233) |
| Wind generation  |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (234)     |
| Hydro-electric generation (Appendix N)   |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (235a)    |
| Electricity generated - Micro CHP (Appendix N)   |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (235)     |
| Appendix Q - special features  |          |           |           |           |           |           |           |           |           |           |          |          |                  |
| Energy saved or generated  |          |           |           |           |           |           |           |           |           |           |          |          | -0.0000 (236)    |
| Energy used  |          |           |           |           |           |           |           |           |           |           |          |          | 0.0000 (237)     |
| Total delivered energy for all uses  |          |           |           |           |           |           |           |           |           |           |          |          | -355.3513 (238)  |

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

|   | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year |
|---|-----------------|----------------------------|-----------------------|
| Space heating - main system 1 (high-rate cost)  | 406.6098        | 0.1636                     | 66.5189 (261)         |
| Space heating - main system 1 (low-rate cost)   | 101.6525        | 0.1373                     | 13.9610 (261)         |
| Total CO2 associated with community systems     |                 |                            | 0.0000 (373)          |
| Water heating - high rate cost                  | 1001.5332       | 0.1479                     | 148.1638 (264)        |
| Water heating - low rate cost                   | 429.2285        | 0.1242                     | 53.2930 (264)         |
| Space and water heating                         |                 |                            | 281.9367 (265)        |
| Pumps, fans and electric keep-hot               | 189.4877        | 0.1432                     | 26.2928 (267)         |
| Energy for lighting                             | 282.5909        | 0.1490                     | 42.1116 (268)         |
| Energy saving/generation technologies           |                 |                            |                       |
| PV Unit electricity used in dwelling            | -2469.8117      | 0.1359                     | -335.6103 (269)       |
| PV Unit electricity exported                    | -296.6422       | 0.1151                     | -34.1524 (270)        |
| Total   |                 |                            | -369.7627 (269)       |
| Total CO2, kg/year                              |                 |                            | -19.4216 (272)        |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                 |                            | -0.2100 (273)         |

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## 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 (high-rate cost) | 406.6098           | 1.2878                              | 654.5653 (275)             |
| Space heating - main system 1 (low-rate cost)  | 101.6525           | 1.4972                              | 152.1928 (275)             |
| Total CO2 associated with community systems    |                    |                                     | 0.0000 (473)               |
| Water heating - high rate cost                 | 1001.5332          | 1.5530                              | 1555.3689 (278)            |
| Water heating - low rate cost                  | 429.2285           | 1.4443                              | 619.9477 (278)             |
| Space and water heating                        |                    |                                     | 2982.0746 (279)            |
| Pumps, fans and electric keep-hot              | 189.4877           | 1.5335                              | 286.6864 (281)             |
| Energy for lighting                            | 282.5909           | 1.5547                              | 439.3566 (282)             |
| Energy saving/generation technologies          |                    |                                     |                            |
| PV Unit electricity used in dwelling           | -2469.8117         | 1.5068                              | -3721.4088                 |
| PV Unit electricity exported                   | -296.6422          | 0.4219                              | -125.1483                  |
| Total  |                    |                                     | -3846.5572 (283)           |
| Total Primary energy kwh/year                  |                    |                                     | -138.4394 (286)            |
| Dwelling Primary energy Rate (DPER)            |                    |                                     | -1.4900 (287)              |

## CAUTION! Results should not be taken from this section

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

### 1. Overall dwelling characteristics

|  | Area<br>(m2) | Storey height<br>(m)              | Volume<br>(m3)    |
|--|--------------|-----------------------------------|-------------------|
| Ground floor   | 46.6000 (1b) | x 2.4000 (2b)                     | = 111.8400 (1b) - |
| First floor  | 46.6000 (1c) | x 2.6500 (2c)                     | = 123.4900 (1c) - |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.2000      |                                   | (4)               |
| Dwelling volume  |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 235.3300 (5)      |

### 2. Ventilation rate

|  |   | m3 per hour                |
|--|---|----------------------------|
| Number of open chimneys                              | 0 * 80 =  | 0.0000 (6a)                |
| Number of open flues                                 | 0 * 20 =  | 0.0000 (6b)                |
| Number of chimneys / flues attached to closed fire   | 0 * 10 =  | 0.0000 (6c)                |
| Number of flues attached to solid fuel boiler        | 0 * 20 =  | 0.0000 (6d)                |
| Number of flues attached to other heater             | 0 * 35 =  | 0.0000 (6e)                |
| Number of blocked chimneys                           | 0 * 20 =  | 0.0000 (6f)                |
| Number of intermittent extract fans                  | 3 * 10 =  | 30.0000 (7a)               |
| Number of passive vents                              | 0 * 10 =  | 0.0000 (7b)                |
| Number of flueless gas fires                         | 0 * 40 =  | 0.0000 (7c)                |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1275 (8) |
| Pressure test  |   | Yes                        |
| Pressure Test Method                                 |   | Blower Door                |
| Measured/design AP50                                 |   | 5.0000 (17)                |
| Infiltration rate                                    |   | 0.3775 (18)                |
| Number of sides sheltered                            |   | 1 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =                           | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =                                  | 0.3492 (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 | 0.4452 | 0.4365 | 0.4277 | 0.3841 | 0.3754 | 0.3317 | 0.3317 | 0.3230 | 0.3492 | 0.3754 | 0.3928 | 0.4103 (22b) |
| Effective ac    | 0.5991 | 0.5952 | 0.5915 | 0.5738 | 0.5704 | 0.5550 | 0.5550 | 0.5522 | 0.5610 | 0.5704 | 0.5772 | 0.5842 (25)  |

### 3. Heat losses and heat loss parameter

| Element                      | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |
|------------------------------|-------------|----------------|---------------|------------------|--------------|-------------------|---------------|
| TER Opaque door              |             |                | 2.1200        | 1.0000           | 2.1200       |                   | (26)          |
| TER Opening Type (Uw = 1.20) |             |                | 13.9600       | 1.1450           | 15.9847      |                   | (27)          |
| Ground Floor                 |             |                | 46.6000       | 0.1300           | 6.0580       |                   | (28a)         |

# Full SAP Calculation Printout



|   |         |        |                      |        |         |       |
|---|---------|--------|----------------------|--------|---------|-------|
| Wall - NE   | 30.7600 | 9.0600 | 21.7000              | 0.1800 | 3.9060  | (29a) |
| Wall - SW   | 30.7600 | 7.0200 | 23.7400              | 0.1800 | 4.2732  | (29a) |
| Wall - NW   | 38.6300 |        | 38.6300              | 0.1800 | 6.9534  | (29a) |
| Roof  | 46.6000 |        | 46.6000              | 0.1100 | 5.1260  | (30)  |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |         |        | 193.3500             |        |         | (31)  |
| Fabric heat loss, W/K = Sum (A x U)                         |         |        | (26)...(30) + (32) = |        | 44.4213 | (33)  |
| Wall - SE   |         |        | 38.6300              | 0.0000 | 0.0000  | (32)  |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 123.7945 (35)

List of Thermal Bridges

| K1 Element   | Length  | Psi-value | Total  |
|--|---------|-----------|--------|
| E3 Sill  | 10.6200 | 0.0500    | 0.5310 |
| E4 Jamb  | 27.1800 | 0.0500    | 1.3590 |
| E2 Other lintels (including other steel lintels)   | 10.6200 | 0.0500    | 0.5310 |
| E5 Ground floor (normal)                           | 19.8300 | 0.1600    | 3.1728 |
| E10 Eaves (insulation at ceiling level)            | 12.1800 | 0.0600    | 0.7308 |
| E12 Gable (insulation at ceiling level)            | 7.6500  | 0.0600    | 0.4590 |
| E16 Corner (normal)                                | 10.1000 | 0.0900    | 0.9090 |
| E18 Party wall between dwellings                   | 10.1000 | 0.0600    | 0.6060 |
| P1 Party wall - Ground floor                       | 7.6500  | 0.0800    | 0.6120 |
| P4 Party wall - Roof (insulation at ceiling level) | 7.6500  | 0.1200    | 0.9180 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.8286 (36)

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 54.2499 (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          |
|---------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Heat transfer coeff       | 46.5253  | 46.2264  | 45.9335  | 44.5577 | 44.3002 | 43.1019 | 43.1019 | 42.8800 | 43.5635 | 44.3002 | 44.8210 | 45.3654 (38) |
| Average = Sum(39)m / 12 = | 100.7752 | 100.4764 | 100.1834 | 98.8076 | 98.5502 | 97.3519 | 97.3519 | 97.1300 | 97.8134 | 98.5502 | 99.0709 | 99.6153 (39) |
|                           |          |          |          |         |         |         |         |         |         |         |         | 98.8064      |

| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP (average) | 1.0813 | 1.0781 | 1.0749 | 1.0602 | 1.0574 | 1.0445 | 1.0445 | 1.0422 | 1.0495 | 1.0574 | 1.0630 | 1.0688 (40) |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31          |

4. Water heating energy requirements (kWh/year)

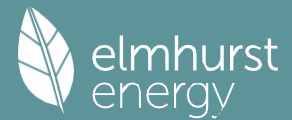
|  |          |          |          |          |          |          |          |          |          |          |          |                |                |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|----------------|
| Assumed occupancy  |          |          |          |          |          |          |          |          |          |          |          |                | 2.6670 (42)    |
| Hot water usage for mixer showers  | 68.9372  | 67.9012  | 66.3916  | 63.5031  | 61.3715  | 58.9944  | 57.6433  | 59.1415  | 60.7838  | 63.3361  | 66.2866  | 68.6731 (42a)  |                |
| Hot water usage for baths  | 29.7685  | 29.3264  | 28.7038  | 27.5559  | 26.6963  | 25.7432  | 25.2284  | 25.8466  | 26.5198  | 27.5396  | 28.7112  | 29.6678 (42b)  |                |
| Hot water usage for other uses   | 41.9431  | 40.4179  | 38.8927  | 37.3675  | 35.8423  | 34.3171  | 34.3171  | 35.8423  | 37.3675  | 38.8927  | 40.4179  | 41.9431 (42c)  |                |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          |                | 129.2880 (43)  |
| Daily hot water use  | 140.6488 | 137.6455 | 133.9881 | 128.4265 | 123.9102 | 119.0548 | 117.1888 | 120.8304 | 124.6711 | 129.7685 | 135.4157 | 140.2840 (44)  |                |
| Energy content (annual)  | 222.7533 | 196.0054 | 205.9347 | 175.8095 | 166.8069 | 146.3917 | 141.7297 | 149.6133 | 153.7319 | 176.0946 | 192.9245 | 219.6509 (45)  |                |
| Distribution loss (46)m = 0.15 x (45)m   | 33.4130  | 29.4008  | 30.8902  | 26.3714  | 25.0210  | 21.9588  | 21.2595  | 22.4420  | 23.0598  | 26.4142  | 28.9387  | 32.9476 (46)   |                |
| Water storage loss:  |          |          |          |          |          |          |          |          |          |          |          |                | 200.0000 (47)  |
| Store volume   |          |          |          |          |          |          |          |          |          |          |          |                | 1.6525 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day):                    |          |          |          |          |          |          |          |          |          |          |          |                | 0.5400 (49)    |
| Temperature factor from Table 2b   |          |          |          |          |          |          |          |          |          |          |          |                | 0.8924 (55)    |
| Enter (49) or (54) in (55)   |          |          |          |          |          |          |          |          |          |          |          |                |                |
| Total storage loss   | 27.6637  | 24.9865  | 27.6637  | 26.7713  | 27.6637  | 26.7713  | 27.6637  | 27.6637  | 26.7713  | 27.6637  | 26.7713  | 27.6637 (56)   |                |
| If cylinder contains dedicated solar storage                                   | 27.6637  | 24.9865  | 27.6637  | 26.7713  | 27.6637  | 26.7713  | 27.6637  | 27.6637  | 26.7713  | 27.6637  | 26.7713  | 27.6637 (57)   |                |
| Primary loss   | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |                |
| Combi loss   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (61)    |                |
| Total heat required for water heating calculated for each month                | 273.6794 | 242.0031 | 256.8608 | 225.0928 | 217.7330 | 195.6750 | 192.6557 | 200.5394 | 203.0152 | 227.0206 | 242.2078 | 270.5770 (62)  |                |
| WMHRS  | -31.5152 | -27.8723 | -29.1863 | -24.1674 | -22.5231 | -19.2732 | -18.0656 | -19.2109 | -19.9408 | -23.5080 | -26.6317 | -30.9316 (63a) |                |
| PV diverter  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000 (63b)  |                |
| Solar input  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63c)   |                |
| FGHRS  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63d)   |                |
| Output from w/h  | 242.1642 | 214.1308 | 227.6745 | 200.9254 | 195.2099 | 176.4018 | 174.5902 | 181.3285 | 183.0744 | 203.5126 | 215.5760 | 239.6454 (64)  |                |
| Total per year (kWh/year)  |          |          |          |          |          |          |          |          |          |          |          |                | 2454.2336 (64) |
| Electric shower(s)   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (64a)   |                |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |          |          |                | 0.0000 (64a)   |
| Heat gains from water heating, kWh/month                                       | 114.8063 | 101.9700 | 109.2141 | 97.8833  | 96.2042  | 88.1019  | 87.8660  | 90.4873  | 90.5425  | 99.2923  | 103.5740 | 113.7748 (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   | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 | 133.3518 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |



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|   |           |           |           |           |           |           |           |           |           |           |           |               |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------|
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 130.5857  | 144.5770  | 130.5857  | 134.9385  | 130.5857  | 134.9385  | 130.5857  | 130.5857  | 134.9385  | 130.5857  | 134.9385  | 130.5857 (67) |
| 244.8433  | 247.3840  | 240.9815  | 227.3513  | 210.1457  | 193.9748  | 183.1717  | 180.6310  | 187.0335  | 200.6636  | 217.8693  | 234.0402  | (68)          |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | (69)          |
| Pumps, fans   | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 3.0000    | 3.0000    | (70)          |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | (71)          |
| Water heating gains (Table 5)   | 154.3096  | 151.7410  | 146.7932  | 135.9490  | 129.3067  | 122.3637  | 118.0994  | 121.6227  | 125.7535  | 133.4574  | 143.8528  | (72)          |
| Total internal gains  | 595.7441  | 609.7076  | 584.3659  | 564.2444  | 536.0436  | 514.2826  | 494.8623  | 495.8449  | 510.7310  | 530.7122  | 562.6662  | (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>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|------------------------------|------------------------------|------------------------------|--------------|
| Northeast | 6.9400     | 11.2829                        | 0.6300                       | 0.7000                       | 0.7700                       | 23.9306 (75) |
| Southwest | 7.0200     | 36.7938                        | 0.6300                       | 0.7000                       | 0.7700                       | 78.9376 (79) |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 102.8682 | 183.1714 | 271.7365 | 372.0839 | 449.0667 | 460.0277 | 437.6029 | 377.9981 | 306.1449 | 208.1361 | 124.6600 | 87.0971 (83)  |
| Total gains | 698.6123 | 792.8789 | 856.1024 | 936.3283 | 985.1102 | 974.3103 | 932.4652 | 873.8430 | 816.8759 | 738.8484 | 687.3261 | 670.6515 (84) |

## 7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         |              | 21.0000 (85) |
|---|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|--------------|
| Utilisation factor for gains for living area, ni1,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |              |
|   | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |              |
| tau   | 31.8025                   | 31.8971 | 31.9903 | 32.4358 | 32.5205 | 32.9208 | 32.9208 | 32.9960 | 32.7655 | 32.5205 | 32.3496 | 32.1728      |              |
| alpha   | 3.1202                    | 3.1265  | 3.1327  | 3.1624  | 3.1680  | 3.1947  | 3.1947  | 3.1997  | 3.1844  | 3.1680  | 3.1566  | 3.1449       |              |
| util living area  | 0.9613                    | 0.9421  | 0.9117  | 0.8432  | 0.7320  | 0.5742  | 0.4379  | 0.4802  | 0.6841  | 0.8670  | 0.9409  | 0.9654 (86)  |              |
| MIT   | 19.0230                   | 19.2963 | 19.6835 | 20.2010 | 20.6151 | 20.8743 | 20.9603 | 20.9463 | 20.7708 | 20.2432 | 19.5641 | 18.9865 (87) |              |
| Th 2  | 20.0162                   | 20.0188 | 20.0214 | 20.0335 | 20.0358 | 20.0464 | 20.0464 | 20.0483 | 20.0423 | 20.0358 | 20.0312 | 20.0264 (88) |              |
| util rest of house  | 0.9550                    | 0.9328  | 0.8972  | 0.8170  | 0.6872  | 0.5057  | 0.3509  | 0.3918  | 0.6201  | 0.8392  | 0.9298  | 0.9598 (89)  |              |
| MIT 2   | 17.7169                   | 18.0616 | 18.5472 | 19.1876 | 19.6705 | 19.9512 | 20.0253 | 20.0179 | 19.8530 | 19.2527 | 18.4116 | 17.6773 (90) |              |
| Living area fraction  | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              | 0.3433 (91)  |
| MIT   | 18.1654                   | 18.4856 | 18.9373 | 19.5355 | 19.9948 | 20.2681 | 20.3463 | 20.3366 | 20.1681 | 19.5928 | 18.8073 | 18.1268 (92) |              |
| Temperature adjustment  |                           |         |         |         |         |         |         |         |         |         |         |              | 0.0000       |
| adjusted MIT  | 18.1654                   | 18.4856 | 18.9373 | 19.5355 | 19.9948 | 20.2681 | 20.3463 | 20.3366 | 20.1681 | 19.5928 | 18.8073 | 18.1268 (93) |              |

## 8. Space heating requirement

|  | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |                            |
|--|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|----------------|----------------------------|
| Utilisation  | 0.9390    | 0.9142    | 0.8775    | 0.8016    | 0.6851   | 0.5224   | 0.3790   | 0.4195   | 0.6291   | 0.8241   | 0.9119    | 0.9448 (94)    |                            |
| Useful gains   | 655.9919  | 724.8448  | 751.1882  | 750.5875  | 674.9164 | 508.9411 | 353.4248 | 366.6001 | 513.9337 | 608.9102 | 626.7571  | 633.6043 (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   | 1397.2870 | 1365.0269 | 1246.0163 | 1050.8715 | 817.4579 | 551.8021 | 364.7122 | 382.3653 | 593.5465 | 886.2433 | 1159.8530 | 1387.3277 (97) |                            |
| Space heating kWh  | 551.5236  | 430.2024  | 368.1521  | 216.2044  | 106.0509 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 206.3359 | 383.8290  | 560.7702 (98a) |                            |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |          |           |                | 2823.0685                  |
| Solar heating kWh  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000 (98b)   |                            |
| Solar heating contribution - total per year (kWh/year)                         |           |           |           |           |          |          |          |          |          |          |           |                | 0.0000                     |
| Space heating kWh  | 551.5236  | 430.2024  | 368.1521  | 216.2044  | 106.0509 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 206.3359 | 383.8290  | 560.7702 (98c) |                            |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |          |           |                | 2823.0685                  |
| Space heating per m2   |           |           |           |           |          |          |          |          |          |          |           |                | (98c) / (4) = 30.2904 (99) |

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

|   | Jan      | Feb      | Mar      | Apr      | May      | Jun    | Jul    | Aug    | Sep    | Oct      | Nov      | Dec            |               |
|---|----------|----------|----------|----------|----------|--------|--------|--------|--------|----------|----------|----------------|---------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |        |        |        |        |          |          |                | 0.0000 (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |        |        |        |        |          |          |                | 1.0000 (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |        |        |        |        |          |          |                | 92.3000 (206) |
| Efficiency of main space heating system 2 (in %)                      |          |          |          |          |          |        |        |        |        |          |          |                | 0.0000 (207)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |        |        |        |        |          |          |                | 0.0000 (208)  |
| Space heating requirement   | 551.5236 | 430.2024 | 368.1521 | 216.2044 | 106.0509 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 206.3359 | 383.8290 | 560.7702 (98)  |               |
| Space heating efficiency (main heating system 1)                      | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000  | 92.3000  | 92.3000 (210)  |               |
| Space heating fuel (main heating system)                              | 597.5337 | 466.0914 | 398.8647 | 234.2410 | 114.8980 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223.5492 | 415.8494 | 607.5517 (211) |               |
| Space heating efficiency (main heating system 2)                      |          |          |          |          |          |        |        |        |        |          |          |                |               |



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|  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         |                  |
|--|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|---------|---------|---------|---------|------------------|
| Space heating fuel (main heating system 2)   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (212)            |
| Space heating fuel (secondary)   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (213)            |
| 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   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (215)            |
| Efficiency of water heater (217)m  | 242.1642 | 214.1308 | 227.6745  | 200.9254  | 195.2099  | 176.4018  | 174.5902  | 181.3285  | 183.0744  | 203.5126 | 215.5760 | 239.6454 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | (64)             |
| Fuel for water heating, kWh/month  | 85.8459  | 85.5919  | 85.1312   | 84.2245   | 82.7524   | 79.8000   | 79.8000   | 79.8000   | 79.8000   | 84.0907  | 85.3385  | 85.8994  | 79.8000 | 79.8000 | 79.8000 | 79.8000 | (216)            |
| Space cooling fuel requirement (221)m  | 282.0916 | 250.1763 | 267.4395  | 238.5594  | 235.8962  | 221.0549  | 218.7847  | 227.2286  | 229.4165  | 242.0156 | 252.6129 | 278.9837 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (217)            |
| Pumps and Fa   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (219)            |
| Lighting   | 7.3041   | 6.5973   | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041   | 7.0685   | 7.3041   | 7.0685  | 7.3041  | 7.0685  | 7.3041  | (221)            |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)m  | 27.1331  | 21.7672  | 19.5989   | 14.3590   | 11.0913   | 9.0617    | 10.1179   | 13.1516   | 17.0826   | 22.4133  | 25.3158  | 27.8872  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (222)            |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m                              | -42.9407 | -60.1977 | -86.0351  | -96.1474  | -103.1600 | -96.0746  | -94.8601  | -89.7939  | -80.7910  | -68.5387 | -47.0772 | -37.1626 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (223)            |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m                  | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (224)            |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (225)            |
| Electricity generated by PVs (Appendix M) (negative quantity) (233b)m  | -25.2908 | -53.0890 | -105.3227 | -157.9172 | -208.5635 | -209.4971 | -207.0561 | -175.4431 | -128.7498 | -75.8596 | -33.7438 | -20.0100 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (226)            |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m                              | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (227)            |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m                  | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (228)            |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | (229)            |
| Annual totals kWh/year   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         |                  |
| Space heating fuel - main system 1   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 3058.5791 (211)  |
| Space heating fuel - main system 2   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 0.0000 (213)     |
| Space heating fuel - secondary   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 0.0000 (215)     |
| Efficiency of water heater   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 79.8000          |
| Water heating fuel used  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 2944.2600 (219)  |
| Space cooling fuel   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 0.0000 (221)     |
| Electricity for pumps and fans:  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         |                  |
| Total electricity for the above, kWh/year  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 86.0000 (231)    |
| Electricity for lighting (calculated in Appendix L)  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 218.9798 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         |                  |
| PV generation  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | -2303.3218 (233) |
| Wind generation  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 0.0000 (234)     |
| Hydro-electric generation (Appendix N)   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 0.0000 (235a)    |
| Electricity generated - Micro CHP (Appendix N)   |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 0.0000 (235)     |
| Appendix Q - special features  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         |                  |
| Energy saved or generated  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | -0.0000 (236)    |
| Energy used  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 0.0000 (237)     |
| Total delivered energy for all uses  |          |          |           |           |           |           |           |           |           |          |          |          |         |         |         |         | 4004.4972 (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                 | 3058.5791          | 0.2100                        | 642.3016 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2944.2600          | 0.2100                        | 618.2946 (264)           |
| Space and water heating                       |                    |                               | 1260.5962 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 218.9798           | 0.1443                        | 31.6056 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -902.7790          | 0.1347                        | -121.6198                |
| PV Unit electricity exported                  | -1400.5427         | 0.1259                        | -176.3892                |
| Total   |                    |                               | -298.0091 (269)          |
| Total CO2, kg/year                            |                    |                               | 1006.1220 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 10.8000 (273)            |

## 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               | 3058.5791          | 1.1300                              | 3456.1944 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2944.2600          | 1.1300                              | 3327.0138 (278)            |
| Space and water heating                     |                    |                                     | 6783.2082 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 218.9798           | 1.5338                              | 335.8785 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -902.7790          | 1.4979                              | -1352.2720                 |
| PV Unit electricity exported                | -1400.5427         | 0.4623                              | -647.4725                  |
| Total                                       |                    |                                     | -1999.7444 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 5249.4431 (286)            |

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Target Primary Energy Rate (TPER)

56.3200 (287)

SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)  
CALCULATION OF FABRIC ENERGY EFFICIENCY

## CAUTION! Results should not be taken from this section

### 1. Overall dwelling characteristics

|  | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--|---------------------------|---------------------------------|-----------------------------|
| Ground floor   | 46.6000 (1b)              | x 2.4000 (2b)                   | = 111.8400 (1b)             |
| First floor  | 46.6000 (1c)              | x 2.6500 (2c)                   | = 123.4900 (1c)             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.2000                   |                                 | (4)                         |
| Dwelling volume  |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 235.3300 (5)              |

### 2. Ventilation rate

|  | m <sup>3</sup> per hour                            |
|--|--|
| Number of open chimneys  | 0 * 80 = 0.0000 (6a)                               |
| Number of open flues   | 0 * 20 = 0.0000 (6b)                               |
| Number of chimneys / flues attached to closed fire   | 0 * 10 = 0.0000 (6c)                               |
| Number of flues attached to solid fuel boiler  | 0 * 20 = 0.0000 (6d)                               |
| Number of flues attached to other heater   | 0 * 35 = 0.0000 (6e)                               |
| Number of blocked chimneys   | 0 * 20 = 0.0000 (6f)                               |
| Number of intermittent extract fans  | 3 * 10 = 30.0000 (7a)                              |
| Number of passive vents  | 0 * 10 = 0.0000 (7b)                               |
| Number of flueless gas fires   | 0 * 40 = 0.0000 (7c)                               |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | Air changes per hour<br>30.0000 / (5) = 0.1275 (8) |
| Pressure test  | Yes  |
| Pressure Test Method   | Blower Door  |
| Measured/design AP50   | 1.0000 (17)  |
| Infiltration rate  | 0.1775 (18)  |
| Number of sides sheltered  | 1 (19)   |
| Shelter factor   | (20) = 1 - [0.075 x (19)] = 0.9250 (20)            |
| Infiltration rate adjusted to include shelter factor   | (21) = (18) x (20) = 0.1642 (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   | 0.2093 | 0.2052 | 0.2011 | 0.1806 | 0.1765 | 0.1560 | 0.1560 | 0.1519 | 0.1642 | 0.1765 | 0.1847 | 0.1929 (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23c) |
| Effective ac  | 0.5219 | 0.5211 | 0.5202 | 0.5163 | 0.5156 | 0.5122 | 0.5122 | 0.5115 | 0.5135 | 0.5156 | 0.5171 | 0.5186 (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   |
|---|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|-----------------|
| Entrance Door   |                         |                            | 2.1200                    | 1.0000                        | 2.1200                       |                                | (26)            |
| Window FF 0.40 (Uw = 1.20)                                  |                         |                            | 4.6000                    | 1.1450                        | 5.2672                       |                                | (27)            |
| Window FF 0.48 (Uw = 1.20)                                  |                         |                            | 5.2400                    | 1.1450                        | 6.0000                       |                                | (27)            |
| Window FF 0.52 (Uw = 1.20)                                  |                         |                            | 3.0900                    | 1.1450                        | 3.5382                       |                                | (27)            |
| Window FF 0.53 (Uw = 1.20)                                  |                         |                            | 0.7300                    | 1.1450                        | 0.8359                       |                                | (27)            |
| Window FF 0.70 (Uw = 1.20)                                  |                         |                            | 0.3000                    | 1.1450                        | 0.3435                       |                                | (27)            |
| Ground Floor  |                         |                            | 46.6000                   | 0.1300                        | 6.0580                       | 75.0000                        | 3495.0000 (28a) |
| Wall - NE   | 30.7600                 | 9.0600                     | 21.7000                   | 0.2000                        | 4.3400                       | 70.0000                        | 1519.0000 (29a) |
| Wall - SW   | 30.7600                 | 7.0200                     | 23.7400                   | 0.2000                        | 4.7480                       | 70.0000                        | 1661.8000 (29a) |
| Wall - NW   | 38.6300                 |                            | 38.6300                   | 0.2000                        | 7.7260                       | 70.0000                        | 2704.1000 (29a) |
| Roof  | 46.6000                 |                            | 46.6000                   | 0.1100                        | 5.1260                       | 9.0000                         | 419.4000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 193.3500                  |                               |                              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           |                               | (26)...(30) + (32) = 46.1027 |                                | (33)            |
| Wall - SE   |                         |                            | 38.6300                   | 0.0000                        | 0.0000                       | 45.0000                        | 1738.3500 (32)  |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 11537.6500 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 123.7945 (35)

#### List of Thermal Bridges

| K1 Element                                       | Length  | Psi-value | Total  |
|--|---------|-----------|--------|
| E3 Sill  | 10.6200 | 0.0500    | 0.5310 |
| E4 Jamb  | 27.1800 | 0.0500    | 1.3590 |
| E2 Other lintels (including other steel lintels) | 10.6200 | 0.0500    | 0.5310 |

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|   |                |                       |                |                |                |                |                |                |                |                |                |                     |
|---|----------------|-----------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| E5 Ground floor (normal)  | 19.8300        | 0.1600                | 3.1728         |                |                |                |                |                |                |                |                |                     |
| E10 Eaves (insulation at ceiling level)   | 12.1800        | 0.0800                | 0.9744         |                |                |                |                |                |                |                |                |                     |
| E12 Gable (insulation at ceiling level)   | 7.6500         | 0.1200                | 0.9180         |                |                |                |                |                |                |                |                |                     |
| E16 Corner (normal)   | 10.1000        | 0.0500                | 0.5050         |                |                |                |                |                |                |                |                |                     |
| E18 Party wall between dwellings  | 10.1000        | 0.0400                | 0.4040         |                |                |                |                |                |                |                |                |                     |
| P1 Party wall - Ground floor  | 7.6500         | 0.1500                | 1.1475         |                |                |                |                |                |                |                |                |                     |
| P4 Party wall - Roof (insulation at ceiling level)  | 7.6500         | 0.1100                | 0.8415         |                |                |                |                |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                  |                |                       | 10.3842 (36)   |                |                |                |                |                |                |                |                |                     |
| Point Thermal bridges   |                |                       | (36a) = 0.0000 |                |                |                |                |                |                |                |                |                     |
| Total fabric heat loss  |                | (33) + (36) + (36a) = | 56.4869 (37)   |                |                |                |                |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38) <sub>m</sub> = 0.33 x (25) <sub>m</sub> x (5) |                |                       |                |                |                |                |                |                |                |                |                |                     |
| (38) <sub>m</sub>   | Jan<br>40.5307 | Feb<br>40.4646        | Mar<br>40.3999 | Apr<br>40.0957 | May<br>40.0388 | Jun<br>39.7739 | Jul<br>39.7739 | Aug<br>39.7249 | Sep<br>39.8760 | Oct<br>40.0388 | Nov<br>40.1539 | Dec<br>40.2743 (38) |
| Heat transfer coeff   | 97.0176        | 96.9516               | 96.8868        | 96.5827        | 96.5258        | 96.2609        | 96.2609        | 96.2118        | 96.3629        | 96.5258        | 96.6409        | 96.7612 (39)        |
| Average = Sum(39) <sub>m</sub> / 12 =   |                |                       |                |                |                |                |                |                |                |                |                | 96.5824             |
| HLP   | Jan<br>1.0410  | Feb<br>1.0403         | Mar<br>1.0396  | Apr<br>1.0363  | May<br>1.0357  | Jun<br>1.0328  | Jul<br>1.0328  | Aug<br>1.0323  | Sep<br>1.0339  | Oct<br>1.0357  | Nov<br>1.0369  | Dec<br>1.0382 (40)  |
| HLP (average)   |                |                       |                |                |                |                |                |                |                |                |                | 1.0363              |
| Days in mont  | 31             | 28                    | 31             | 30             | 31             | 30             | 31             | 31             | 30             | 31             | 30             | 31                  |

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

|  |                |                |                |                |                |                |                |                |                |                |                |                     |  |
|--|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|--|
| Assumed occupancy  |                |                |                |                |                |                |                |                |                |                |                |                     | 2.6670 (42)  |
| Hot water usage for mixer showers  | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000              | 0.0000 (42a)   |
| Hot water usage for baths  | 29.7685        | 29.3264        | 28.7038        | 27.5559        | 26.6963        | 25.7432        | 25.2284        | 25.8466        | 26.5198        | 27.5396        | 28.7112        | 29.6678             | 29.6678 (42b)  |
| Hot water usage for other uses   | 41.9431        | 40.4179        | 38.8927        | 37.3675        | 35.8423        | 34.3171        | 34.3171        | 35.8423        | 37.3675        | 38.8927        | 40.4179        | 41.9431             | 41.9431 (42c)  |
| Average daily hot water use (litres/day)   |                |                |                |                |                |                |                |                |                |                |                |                     | 65.7302 (43)   |
| Daily hot water use  | Jan<br>71.7116 | Feb<br>69.7443 | Mar<br>67.5965 | Apr<br>64.9234 | May<br>62.5386 | Jun<br>60.0603 | Jul<br>59.5455 | Aug<br>61.6889 | Sep<br>63.8873 | Oct<br>66.4323 | Nov<br>69.1291 | Dec<br>71.6110 (44) |  |
| Energy content   | 113.5736       | 99.3149        | 103.8933       | 88.8769        | 84.1890        | 73.8512        | 72.0151        | 76.3838        | 78.7794        | 90.1480        | 98.4871        | 112.1255 (45)       |  |
| Energy content (annual)  |                |                |                |                |                |                |                |                |                |                |                |                     | Total = Sum(45) <sub>m</sub> = 1091.6379                         |
| Distribution loss (46) <sub>m</sub> = 0.15 x (45) <sub>m</sub>                             | 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)         |  |
| Combi loss   | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000 (61)         |  |
| Total heat required for water heating calculated for each month                            | 96.5376        | 84.4177        | 88.3093        | 75.5453        | 71.5607        | 62.7735        | 61.2129        | 64.9262        | 66.9625        | 76.6258        | 83.7140        | 95.3066 (62)        |  |
| MWHR   | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000 (63a)        |  |
| PV diverter  | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000 (63b)        |  |
| Solar input  | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000 (63c)        |  |
| FGHRS  | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000         | 0.0000 (63d)        |  |
| Output from w/h  | 96.5376        | 84.4177        | 88.3093        | 75.5453        | 71.5607        | 62.7735        | 61.2129        | 64.9262        | 66.9625        | 76.6258        | 83.7140        | 95.3066 (64)        |  |
| 12Total per year (kWh/year)  |                |                |                |                |                |                |                |                |                |                |                |                     | Total per year (kWh/year) = Sum(64) <sub>m</sub> = 927.8923 (64) |
| Electric shower(s)   | 55.2072        | 49.1901        | 53.7137        | 51.2583        | 52.2202        | 49.8130        | 51.4734        | 52.2202        | 51.2583        | 53.7137        | 52.7037        | 55.2072 (64a)       |  |
| Heat gains from water heating, kWh/month   | 37.9362        | 33.4019        | 35.5058        | 31.7009        | 30.9452        | 28.1466        | 28.1716        | 29.2866        | 29.5552        | 32.5849        | 34.1044        | 37.6285 (65)        |  |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a) <sub>m</sub> = |                |                |                |                |                |                |                |                |                |                |                |                     | 627.9788 (64a)   |

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

|   |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|
| Metabolic gains (Table 5), Watts  | Jan<br>133.3518 | Feb<br>133.3518 | Mar<br>133.3518 | Apr<br>133.3518 | May<br>133.3518 | Jun<br>133.3518 | Jul<br>133.3518 | Aug<br>133.3518 | Sep<br>133.3518 | Oct<br>133.3518 | Nov<br>133.3518 | Dec<br>133.3518 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 142.4430        | 157.7047        | 142.4430        | 147.1911        | 142.4430        | 147.1911        | 142.4430        | 142.4430        | 147.1911        | 142.4430        | 147.1911        | 142.4430 (67)        |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 244.8433        | 247.3840        | 240.9815        | 227.3513        | 210.1457        | 193.9748        | 183.1717        | 180.6310        | 187.0335        | 200.6636        | 217.8693        | 234.0402 (68)        |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352         | 36.3352 (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)                                 | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815       | -106.6815 (71)       |
| Water heating gains (Table 5)   | 50.9895         | 49.7053         | 47.7228         | 44.0290         | 41.5930         | 39.0925         | 37.8650         | 39.3637         | 41.0489         | 43.7969         | 47.3672         | 50.5759 (72)         |
| Total internal gains  | 501.2814        | 517.7996        | 494.1528        | 481.5770        | 457.1873        | 443.2640        | 426.4852        | 425.4432        | 438.2790        | 449.9091        | 475.4332        | 490.0646 (73)        |

## 6. Solar gains

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| [Jan]     |  | Area<br>m <sup>2</sup> | Solar flux<br>Table 6a<br>W/m <sup>2</sup> | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|--|------------------------|--|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast |  | 4.6000                 | 11.2829                                    | 0.6200                            | 0.4000                             | 0.7700                       | 8.9200 (75)  |
| Northeast |  | 1.3100                 | 11.2829                                    | 0.6200                            | 0.4800                             | 0.7700                       | 3.0483 (75)  |
| Southwest |  | 3.9300                 | 36.7938                                    | 0.6200                            | 0.4800                             | 0.7700                       | 29.8218 (79) |
| Southwest |  | 3.0900                 | 36.7938                                    | 0.6200                            | 0.5200                             | 0.7700                       | 25.4016 (79) |
| Northeast |  | 0.7300                 | 11.2829                                    | 0.6200                            | 0.5300                             | 0.7700                       | 1.8756 (75)  |
| Northeast |  | 0.3000                 | 11.2829                                    | 0.6200                            | 0.7000                             | 0.7700                       | 1.0180 (75)  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 70.0854  | 124.3179 | 183.2096 | 248.9839 | 298.9435 | 305.6058 | 290.9644 | 252.3433 | 205.7750 | 140.9332 | 84.8452  | 59.3968 (83)  |
| Total gains | 571.3668 | 642.1175 | 677.3624 | 730.5609 | 756.1308 | 748.8698 | 717.4497 | 677.7865 | 644.0540 | 590.8423 | 560.2783 | 549.4614 (84) |

## 7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         |              |
|---|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| 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   | 33.0342                   | 33.0567 | 33.0788 | 33.1830 | 33.2026 | 33.2939 | 33.2939 | 33.3109 | 33.2587 | 33.2026 | 33.1630 | 33.1218      |
| alpha   | 3.2023                    | 3.2038  | 3.2053  | 3.2122  | 3.2135  | 3.2196  | 3.2196  | 3.2207  | 3.2172  | 3.2135  | 3.2109  | 3.2081       |
| util living area  | 0.9767                    | 0.9650  | 0.9476  | 0.9038  | 0.8235  | 0.6840  | 0.5407  | 0.5842  | 0.7749  | 0.9161  | 0.9639  | 0.9794 (86)  |
| MIT   | 18.8975                   | 19.1363 | 19.4890 | 19.9923 | 20.4547 | 20.7939 | 20.9292 | 20.9074 | 20.6710 | 20.0828 | 19.4080 | 18.8456 (87) |
| Th 2  | 20.0493                   | 20.0499 | 20.0505 | 20.0532 | 20.0537 | 20.0561 | 20.0561 | 20.0565 | 20.0551 | 20.0537 | 20.0527 | 20.0516 (88) |
| util rest of house  | 0.9727                    | 0.9590  | 0.9381  | 0.8852  | 0.7866  | 0.6152  | 0.4419  | 0.4868  | 0.7171  | 0.8962  | 0.9567  | 0.9759 (89)  |
| MIT 2   | 18.1250                   | 18.3610 | 18.7090 | 19.1997 | 19.6342 | 19.9281 | 20.0250 | 20.0131 | 19.8330 | 19.2942 | 18.6341 | 18.0751 (90) |
| Living area fraction  | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         | 0.3433 (91)  |
| MIT   | 18.3902                   | 18.6272 | 18.9768 | 19.4719 | 19.9159 | 20.2254 | 20.3355 | 20.3202 | 20.1207 | 19.5650 | 18.8998 | 18.3397 (92) |
| Temperature adjustment  | 0.0000                    |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT  | 18.3902                   | 18.6272 | 18.9768 | 19.4719 | 19.9159 | 20.2254 | 20.3355 | 20.3202 | 20.1207 | 19.5650 | 18.8998 | 18.3397 (93) |

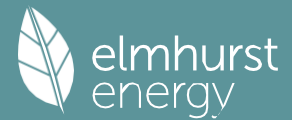
## 8. Space heating requirement

|  | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec                        |
|--|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|----------------------------|
| Utilisation  | 0.9634    | 0.9474    | 0.9247    | 0.8716    | 0.7805   | 0.6285   | 0.4726   | 0.5157   | 0.7216   | 0.8836   | 0.9453    | 0.9672 (94)                |
| Useful gains   | 550.4777  | 608.3696  | 626.3770  | 636.7507  | 590.1714 | 470.6743 | 339.0658 | 349.5106 | 464.7637 | 522.0759 | 529.6433  | 531.4600 (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   | 1367.0000 | 1330.8768 | 1208.8392 | 1021.0577 | 793.0470 | 541.5025 | 359.5810 | 377.1687 | 580.1757 | 865.3520 | 1140.3461 | 1368.1714 (97)             |
| Space heating kWh  | 607.4925  | 485.5248  | 433.3519  | 276.7011  | 150.9395 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 255.3975 | 439.7060  | 622.5133 (98a)             |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |          |           | 3271.6265                  |
| Solar heating kWh  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000 (98b)               |
| Solar heating contribution - total per year (kWh/year)                         |           |           |           |           |          |          |          |          |          |          |           | 0.0000                     |
| Space heating kWh  | 607.4925  | 485.5248  | 433.3519  | 276.7011  | 150.9395 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 255.3975 | 439.7060  | 622.5133 (98c)             |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |          |           | 3271.6265                  |
| Space heating per m <sup>2</sup>   |           |           |           |           |          |          |          |          |          |          |           | (98c) / (4) = 35.1033 (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  | 904.8521 | 712.3304 | 731.2097 | 0.0000  | 0.0000  | 0.0000 | 0.0000 (100)                          |
| Utilisation   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7168   | 0.7927   | 0.7616   | 0.0000  | 0.0000  | 0.0000 | 0.0000 (101)                          |
| Useful loss   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 648.5890 | 564.6310 | 556.9006 | 0.0000  | 0.0000  | 0.0000 | 0.0000 (102)                          |
| Total gains   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 805.2820 | 771.8208 | 728.4237 | 0.0000  | 0.0000  | 0.0000 | 0.0000 (103)                          |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 112.8190 | 154.1492 | 127.6132 | 0.0000  | 0.0000  | 0.0000 | 0.0000 (104)                          |
| Cooled fraction                                     |        |        |        |        |         |          |          |          |         |         |        | fC = cooled area / (4) = 1.0000 (105) |
| Intermittency factor (Table 10b)                    | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500  | 0.2500   | 0.2500   | 0.2500   | 0.2500  | 0.2500  | 0.2500 | 0.2500 (106)                          |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 28.2047  | 38.5373  | 31.9033  | 0.0000  | 0.0000  | 0.0000 | 0.0000 (107)                          |
| Space cooling requirement                           |        |        |        |        |         |          |          |          |         |         |        | 98.6453 (107)                         |
| Energy for space heating                            |        |        |        |        |         |          |          |          |         |         |        | 35.1033 (99)                          |
| Energy for space cooling                            |        |        |        |        |         |          |          |          |         |         |        | 1.0584 (108)                          |
| Total   |        |        |        |        |         |          |          |          |         |         |        | 36.1617 (109)                         |
| Fabric Energy Efficiency (DFEE)                     |        |        |        |        |         |          |          |          |         |         |        | 36.2 (109)                            |

# Full SAP Calculation Printout



SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)  
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

## CAUTION! Results should not be taken from this section

### 1. Overall dwelling characteristics

|  | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--|---------------------------|---------------------------------|-----------------------------|
| Ground floor   | 46.6000 (1b)              | x 2.4000 (2b)                   | = 111.8400 (1b) -           |
| First floor  | 46.6000 (1c)              | x 2.6500 (2c)                   | = 123.4900 (1c) -           |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.2000                   |                                 | (4)                         |
| Dwelling volume  |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 235.3300 (5)              |

### 2. Ventilation rate

|   |   | m <sup>3</sup> per hour |
|---|---|-------------------------|
| Number of open chimneys   | 0 * 80 =  | 0.0000 (6a)             |
| Number of open flues  | 0 * 20 =  | 0.0000 (6b)             |
| Number of chimneys / flues attached to closed fire  | 0 * 10 =  | 0.0000 (6c)             |
| Number of flues attached to solid fuel boiler   | 0 * 20 =  | 0.0000 (6d)             |
| Number of flues attached to other heater  | 0 * 35 =  | 0.0000 (6e)             |
| Number of blocked chimneys  | 0 * 20 =  | 0.0000 (6f)             |
| Number of intermittent extract fans   | 3 * 10 =  | 30.0000 (7a)            |
| Number of passive vents   | 0 * 10 =  | 0.0000 (7b)             |
| Number of flueless gas fires  | 0 * 40 =  | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =      | 30.0000 / (5) =   | 0.1275 (8)              |
| Pressure test   |   | Yes                     |
| Pressure Test Method  |   | Blower Door             |
| Measured/design AP50  |   | 5.0000 (17)             |
| Infiltration rate   |   | 0.3775 (18)             |
| Number of sides sheltered   |   | 1 (19)                  |
| Shelter factor  | (20) = 1 - [0.075 x (19)] =   | 0.9250 (20)             |
| Infiltration rate adjusted to include shelter factor  | (21) = (18) x (20) =  | 0.3492 (21)             |
| Wind speed  | Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 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   | 0.4452 0.4365 0.4277 0.3841 0.3754 0.3317 0.3317 0.3230 0.3492 0.3754 0.3928 0.4103   | (22b)                   |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |   | 0.0000 (23b)            |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |   | 0.0000 (23c)            |
| Effective ac  | 0.5991 0.5952 0.5915 0.5738 0.5704 0.5550 0.5550 0.5522 0.5610 0.5704 0.5772 0.5842   | (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   |                         |                            | 2.1200                    | 1.0000                        | 2.1200               |                                | (26)          |
| TER Opening Type (Uw = 1.20)                                |                         |                            | 13.9600                   | 1.1450                        | 15.9847              |                                | (27)          |
| Ground Floor  |                         |                            | 46.6000                   | 0.1300                        | 6.0580               |                                | (28a)         |
| Wall - NE   | 30.7600                 | 9.0600                     | 21.7000                   | 0.1800                        | 3.9060               |                                | (29a)         |
| Wall - SW   | 30.7600                 | 7.0200                     | 23.7400                   | 0.1800                        | 4.2732               |                                | (29a)         |
| Wall - NW   | 38.6300                 |                            | 38.6300                   | 0.1800                        | 6.9534               |                                | (29a)         |
| Roof  | 46.6000                 |                            | 46.6000                   | 0.1100                        | 5.1260               |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 193.3500                  |                               |                      |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           |                               | (26)...(30) + (32) = | 44.4213                        | (33)          |
| Wall - SE   |                         |                            | 38.6300                   | 0.0000                        | 0.0000               |                                | (32)          |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 123.7945 (35)

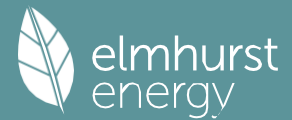
#### List of Thermal Bridges

|  | Length  | Psi-value | Total                              |
|--|---------|-----------|------------------------------------|
| K1 Element   | 10.6200 | 0.0500    | 0.5310                             |
| E3 Sill  | 27.1800 | 0.0500    | 1.3590                             |
| E4 Jamb  | 10.6200 | 0.0500    | 0.5310                             |
| E2 Other lintels (including other steel lintels)           | 19.8300 | 0.1600    | 3.1728                             |
| E5 Ground floor (normal)                                   | 12.1800 | 0.0600    | 0.7308                             |
| E10 Eaves (insulation at ceiling level)                    | 7.6500  | 0.0600    | 0.4590                             |
| E12 Gable (insulation at ceiling level)                    | 10.1000 | 0.0900    | 0.9090                             |
| E16 Corner (normal)  | 10.1000 | 0.0600    | 0.6060                             |
| E18 Party wall between dwellings                           | 7.6500  | 0.0800    | 0.6120                             |
| P1 Party wall - Ground floor                               | 7.6500  | 0.1200    | 0.9180                             |
| P4 Party wall - Roof (insulation at ceiling level)         |         |           |                                    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |         |           | 9.8286 (36)                        |
| Point Thermal bridges                                      |         |           | (36a) = 0.0000                     |
| Total fabric heat loss                                     |         |           | (33) + (36) + (36a) = 54.2499 (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          |
|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
|       | 46.5253 | 46.2264 | 45.9335 | 44.5577 | 44.3002 | 43.1019 | 43.1019 | 42.8800 | 43.5635 | 44.3002 | 44.8210 | 45.3654 (38) |

# Full SAP Calculation Printout



|                           |          |          |          |         |         |         |         |         |         |         |         |              |
|---------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Heat transfer coeff       | 100.7752 | 100.4764 | 100.1834 | 98.8076 | 98.5502 | 97.3519 | 97.3519 | 97.1300 | 97.8134 | 98.5502 | 99.0709 | 99.6153 (39) |
| Average = Sum(39)m / 12 = |          |          |          |         |         |         |         |         |         |         |         | 98.8064      |
|                           | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                       | 1.0813   | 1.0781   | 1.0749   | 1.0602  | 1.0574  | 1.0445  | 1.0445  | 1.0422  | 1.0495  | 1.0574  | 1.0630  | 1.0688 (40)  |
| HLP (average)             |          |          |          |         |         |         |         |         |         |         |         | 1.0602       |
| Days in mont              | 31       | 28       | 31       | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31           |

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

|   |          |         |          |         |         |         |         |         |         |         |         |                |
|---|----------|---------|----------|---------|---------|---------|---------|---------|---------|---------|---------|----------------|
| Assumed occupancy   |          |         |          |         |         |         |         |         |         |         |         | 2.6670 (42)    |
| Hot water usage for mixer showers                               | 0.0000   | 0.0000  | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (42a)   |
| Hot water usage for baths                                       | 29.7685  | 29.3264 | 28.7038  | 27.5559 | 26.6963 | 25.7432 | 25.2284 | 25.8466 | 26.5198 | 27.5396 | 28.7112 | 29.6678 (42b)  |
| Hot water usage for other uses                                  | 41.9431  | 40.4179 | 38.8927  | 37.3675 | 35.8423 | 34.3171 | 34.3171 | 35.8423 | 37.3675 | 38.8927 | 40.4179 | 41.9431 (42c)  |
| Average daily hot water use (litres/day)                        |          |         |          |         |         |         |         |         |         |         |         | 65.7302 (43)   |
|   | Jan      | Feb     | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec            |
| Daily hot water use   | 71.7116  | 69.7443 | 67.5965  | 64.9234 | 62.5386 | 60.0603 | 59.5455 | 61.6889 | 63.8873 | 66.4323 | 69.1291 | 71.6110 (44)   |
| Energy conte  | 113.5736 | 99.3149 | 103.8933 | 88.8769 | 84.1890 | 73.8512 | 72.0151 | 76.3838 | 78.7794 | 90.1480 | 98.4871 | 112.1255 (45)  |
| Energy content (annual)   |          |         |          |         |         |         |         |         |         |         |         | 1091.6379      |
| 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)    |
| Combi loss  | 0.0000   | 0.0000  | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (61)    |
| Total heat required for water heating calculated for each month | 96.5376  | 84.4177 | 88.3093  | 75.5453 | 71.5607 | 62.7735 | 61.2129 | 64.9262 | 66.9625 | 76.6258 | 83.7140 | 95.3066 (62)   |
| WMHRS   | 0.0000   | 0.0000  | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63a)   |
| PV diverter   | 0.0000   | 0.0000  | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63b)   |
| Solar input   | 0.0000   | 0.0000  | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63c)   |
| FGHRS   | 0.0000   | 0.0000  | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63d)   |
| Output from w/h   | 96.5376  | 84.4177 | 88.3093  | 75.5453 | 71.5607 | 62.7735 | 61.2129 | 64.9262 | 66.9625 | 76.6258 | 83.7140 | 95.3066 (64)   |
|   |          |         |          |         |         |         |         |         |         |         |         | 927.8923 (64)  |
| 12Total per year (kWh/year)                                     |          |         |          |         |         |         |         |         |         |         |         | 928 (64)       |
| Electric shower(s)  | 55.2072  | 49.1901 | 53.7137  | 51.2583 | 52.2202 | 49.8130 | 51.4734 | 52.2202 | 51.2583 | 53.7137 | 52.7037 | 55.2072 (64a)  |
|   |          |         |          |         |         |         |         |         |         |         |         | 627.9788 (64a) |
| Heat gains from water heating, kWh/month                        | 37.9362  | 33.4019 | 35.5058  | 31.7009 | 30.9452 | 28.1466 | 28.1716 | 29.2866 | 29.5552 | 32.5849 | 34.1044 | 37.6285 (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   | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518  | 133.3518 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 130.5857  | 144.5770  | 130.5857  | 134.9385  | 130.5857  | 134.9385  | 130.5857  | 130.5857  | 134.9385  | 130.5857  | 134.9385  | 130.5857 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 244.8433  | 247.3840  | 240.9815  | 227.3513  | 210.1457  | 193.9748  | 183.1717  | 180.6310  | 187.0335  | 200.6636  | 217.8693  | 234.0402 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352   | 36.3352 (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)                                 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 (71) |
| Water heating gains (Table 5)   | 50.9895   | 49.7053   | 47.7228   | 44.0290   | 41.5930   | 39.0925   | 37.8650   | 39.3637   | 41.0489   | 43.7969   | 47.3672   | 50.5759 (72)   |
| Total internal gains  | 489.4240  | 504.6718  | 482.2955  | 469.3244  | 445.3299  | 431.0114  | 414.6279  | 413.5859  | 426.0264  | 438.0517  | 463.1806  | 478.2073 (73)  |

## 6. Solar gains

|             |          |            |               |               |          |              |          |          |          |          |          |               |
|-------------|----------|------------|---------------|---------------|----------|--------------|----------|----------|----------|----------|----------|---------------|
| [Jan]       | Area     | Solar flux | g             | FF            | Access   | Gains        |          |          |          |          |          |               |
|             | m2       | Table 6a   | Specific data | Specific data | factor   | W            |          |          |          |          |          |               |
|             |          | W/m2       | or Table 6b   | or Table 6c   | Table 6d |              |          |          |          |          |          |               |
| Northeast   | 6.9400   | 11.2829    | 0.6300        | 0.7000        | 0.7700   | 23.9306 (75) |          |          |          |          |          |               |
| Southwest   | 7.0200   | 36.7938    | 0.6300        | 0.7000        | 0.7700   | 78.9376 (79) |          |          |          |          |          |               |
| Solar gains | 102.8682 | 183.1714   | 271.7365      | 372.0839      | 449.0667 | 460.0277     | 437.6029 | 377.9981 | 306.1449 | 208.1361 | 124.6600 | 87.0971 (83)  |
| Total gains | 592.2922 | 687.8432   | 754.0320      | 841.4084      | 894.3966 | 891.0391     | 852.2308 | 791.5840 | 732.1713 | 646.1879 | 587.8405 | 565.3043 (84) |

# Full SAP Calculation Printout



## 7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|   | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau   | 31.8025 | 31.8971 | 31.9903 | 32.4358 | 32.5205 | 32.9208 | 32.9208 | 32.9960 | 32.7655                   | 32.5205 | 32.3496 | 32.1728 |              |
| alpha   | 3.1202  | 3.1265  | 3.1327  | 3.1624  | 3.1680  | 3.1947  | 3.1947  | 3.1997  | 3.1844                    | 3.1680  | 3.1566  | 3.1449  |              |
| util living area  | 0.9747  | 0.9591  | 0.9339  | 0.8731  | 0.7693  | 0.6129  | 0.4732  | 0.5211  | 0.7292                    | 0.8996  | 0.9598  | 0.9779  | (86)         |
| MIT   | 18.8388 | 19.1256 | 19.5341 | 20.0930 | 20.5501 | 20.8479 | 20.9505 | 20.9321 | 20.7216                   | 20.1264 | 19.4020 | 18.8008 | (87)         |
| Th 2  | 20.0162 | 20.0188 | 20.0214 | 20.0335 | 20.0358 | 20.0464 | 20.0464 | 20.0483 | 20.0423                   | 20.0358 | 20.0312 | 20.0264 | (88)         |
| util rest of house  | 0.9704  | 0.9522  | 0.9224  | 0.8502  | 0.7268  | 0.5433  | 0.3813  | 0.4281  | 0.6672                    | 0.8766  | 0.9518  | 0.9741  | (89)         |
| MIT 2   | 18.0437 | 18.3280 | 18.7304 | 19.2765 | 19.6982 | 19.9552 | 20.0255 | 20.0177 | 19.8592                   | 19.3201 | 18.6126 | 18.0133 | (90)         |
| Living area fraction  |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3433  | (91)         |
| MIT   | 18.3167 | 18.6019 | 19.0063 | 19.5568 | 19.9907 | 20.2617 | 20.3431 | 20.3317 | 20.1553                   | 19.5969 | 18.8837 | 18.2837 | (92)         |
| Temperature adjustment  |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT  | 18.3167 | 18.6019 | 19.0063 | 19.5568 | 19.9907 | 20.2617 | 20.3431 | 20.3317 | 20.1553                   | 19.5969 | 18.8837 | 18.2837 | (93)         |

## 8. Space heating requirement

|  | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec           |              |
|--|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|---------------|--------------|
| Utilisation  | 0.9603    | 0.9394    | 0.9075    | 0.8371    | 0.7247   | 0.5599   | 0.4109   | 0.4570   | 0.6752   | 0.8641   | 0.9396    | 0.9649        | (94)         |
| Useful gains   | 568.7961  | 646.1435  | 684.3022  | 704.3555  | 648.1323 | 498.8892 | 350.1729 | 361.7536 | 494.3485 | 558.3695 | 552.3266  | 545.4895      | (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   | 1412.5362 | 1376.7131 | 1252.9281 | 1052.9758 | 817.0490 | 551.1789 | 364.3951 | 381.8812 | 592.2883 | 886.6490 | 1167.4182 | 1402.9522     | (97)         |
| Space heating kWh  | 627.7426  | 490.9427  | 423.0577  | 251.0066  | 125.6740 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 244.2399 | 442.8659  | 637.9523      | (98a)        |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |          |           | 3243.4818     |              |
| Solar heating kWh  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000        | (98b)        |
| Solar heating contribution - total per year (kWh/year)                         |           |           |           |           |          |          |          |          |          |          |           | 0.0000        |              |
| Space heating kWh  | 627.7426  | 490.9427  | 423.0577  | 251.0066  | 125.6740 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 244.2399 | 442.8659  | 637.9523      | (98c)        |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |          |           | 3243.4818     |              |
| Space heating per m2   |           |           |           |           |          |          |          |          |          |          |           | (98c) / (4) = | 34.8013 (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  | 915.1076 | 720.4039 | 738.1877 | 0.0000                   | 0.0000  | 0.0000 | 0.0000   | (100) |
| Utilisation   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7887   | 0.8522   | 0.8217   | 0.0000                   | 0.0000  | 0.0000 | 0.0000   | (101) |
| Useful loss   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 721.7852 | 613.8989 | 606.6036 | 0.0000                   | 0.0000  | 0.0000 | 0.0000   | (102) |
| Total gains   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 984.7376 | 942.0954 | 873.8358 | 0.0000                   | 0.0000  | 0.0000 | 0.0000   | (103) |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 189.3257 | 244.1782 | 198.8208 | 0.0000                   | 0.0000  | 0.0000 | 0.0000   | (104) |
| Cooled fraction                                     |        |        |        |        |         |          |          |          | fc = cooled area / (4) = |         |        | 1.0000   | (105) |
| Intermittency factor (Table 10b)                    | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500  | 0.2500   | 0.2500   | 0.2500   | 0.2500                   | 0.2500  | 0.2500 | 0.2500   | (106) |
| Space cooling kWh                                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 47.3314  | 61.0445  | 49.7052  | 0.0000                   | 0.0000  | 0.0000 | 0.0000   | (107) |
| Space cooling requirement                           |        |        |        |        |         |          |          |          |                          |         |        | 158.0812 | (107) |
| Energy for space heating                            |        |        |        |        |         |          |          |          |                          |         |        | 34.8013  | (99)  |
| Energy for space cooling                            |        |        |        |        |         |          |          |          |                          |         |        | 1.6961   | (108) |
| Total   |        |        |        |        |         |          |          |          |                          |         |        | 36.4975  | (109) |
| Fabric Energy Efficiency (TFEE)                     |        |        |        |        |         |          |          |          |                          |         |        | 36.5     | (109) |

**CAUTION! Results should not be taken from this section**

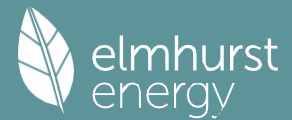
SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING

## 1. Overall dwelling characteristics

|  | Area (m2)    | Storey height (m)                 | Volume (m3)     |   |
|--|--------------|-----------------------------------|-----------------|---|
| Ground floor   | 46.6000 (1b) | x 2.4000 (2b)                     | = 111.8400 (1b) | - |
| First floor  | 46.6000 (1c) | x 2.6500 (2c)                     | = 123.4900 (1c) | - |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.2000      |                                   | (4)             |   |
| Dwelling volume  |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 235.3300 (5)    |   |



# Full SAP Calculation Printout



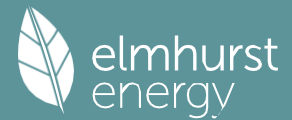
## 2. Ventilation rate

|   |        |        |        |        |        |        |        |        |        |        |        | m3 per hour                             |             |               |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---|-------------|---------------|
| Number of open chimneys   |        |        |        |        |        |        |        |        |        |        |        | 0 * 80 =                                | 0.0000 (6a) |               |
| Number of open flues  |        |        |        |        |        |        |        |        |        |        |        | 0 * 20 =                                | 0.0000 (6b) |               |
| Number of chimneys / flues attached to closed fire  |        |        |        |        |        |        |        |        |        |        |        | 0 * 10 =                                | 0.0000 (6c) |               |
| Number of flues attached to solid fuel boiler   |        |        |        |        |        |        |        |        |        |        |        | 0 * 20 =                                | 0.0000 (6d) |               |
| Number of flues attached to other heater  |        |        |        |        |        |        |        |        |        |        |        | 0 * 35 =                                | 0.0000 (6e) |               |
| Number of blocked chimneys  |        |        |        |        |        |        |        |        |        |        |        | 0 * 20 =                                | 0.0000 (6f) |               |
| Number of intermittent extract fans   |        |        |        |        |        |        |        |        |        |        |        | 0 * 10 =                                | 0.0000 (7a) |               |
| Number of passive vents   |        |        |        |        |        |        |        |        |        |        |        | 0 * 10 =                                | 0.0000 (7b) |               |
| Number of flueless gas fires  |        |        |        |        |        |        |        |        |        |        |        | 0 * 40 =                                | 0.0000 (7c) |               |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =      |        |        |        |        |        |        |        |        |        |        |        | 0.0000 / (5) =                          | 0.0000 (8)  |               |
| Pressure test   |        |        |        |        |        |        |        |        |        |        |        | Yes                                     |             |               |
| Pressure Test Method  |        |        |        |        |        |        |        |        |        |        |        | Blower Door                             |             |               |
| Measured/design AP50  |        |        |        |        |        |        |        |        |        |        |        | 1.0000 (17)                             |             |               |
| Infiltration rate   |        |        |        |        |        |        |        |        |        |        |        | 0.0500 (18)                             |             |               |
| Number of sides sheltered   |        |        |        |        |        |        |        |        |        |        |        | 1 (19)                                  |             |               |
| Shelter factor  |        |        |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |             |               |
| Infiltration rate adjusted to include shelter factor  |        |        |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) = 0.0463 (21)        |             |               |
| Wind speed  | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec                                     |             |               |
|   | 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   | 0.0590 | 0.0578 | 0.0567 | 0.0509 | 0.0497 | 0.0439 | 0.0439 | 0.0428 | 0.0463 | 0.0497 | 0.0520 | 0.0543                                  | (22b)       |               |
| Balanced mechanical ventilation with heat recovery  |        |        |        |        |        |        |        |        |        |        |        |   |             |               |
| If mechanical ventilation   |        |        |        |        |        |        |        |        |        |        |        |   |             | 0.5000 (23a)  |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        |   |             | 0.5000 (23b)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        |   |             | 79.2000 (23c) |
| Effective ac  | 0.1630 | 0.1618 | 0.1607 | 0.1549 | 0.1537 | 0.1479 | 0.1479 | 0.1468 | 0.1502 | 0.1537 | 0.1560 | 0.1583                                  | (25)        |               |

## 3. Heat losses and heat loss parameter

| Element   | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K         | K-value<br>kJ/m2K | A x K<br>kJ/K                        |                 |         |         |         |         |         |
|---|-------------|----------------|---------------|------------------|----------------------|-------------------|--------------------------------------|-----------------|---------|---------|---------|---------|---------|
| Entrance Door   |             |                | 2.1200        | 1.0000           | 2.1200               |                   |                                      | (26)            |         |         |         |         |         |
| Window FF 0.40 (Uw = 1.20)  |             |                | 4.6000        | 1.1450           | 5.2672               |                   |                                      | (27)            |         |         |         |         |         |
| Window FF 0.48 (Uw = 1.20)  |             |                | 5.2400        | 1.1450           | 6.0000               |                   |                                      | (27)            |         |         |         |         |         |
| Window FF 0.52 (Uw = 1.20)  |             |                | 3.0900        | 1.1450           | 3.5382               |                   |                                      | (27)            |         |         |         |         |         |
| Window FF 0.53 (Uw = 1.20)  |             |                | 0.7300        | 1.1450           | 0.8359               |                   |                                      | (27)            |         |         |         |         |         |
| Window FF 0.70 (Uw = 1.20)  |             |                | 0.3000        | 1.1450           | 0.3435               |                   |                                      | (27)            |         |         |         |         |         |
| Ground Floor  |             |                | 46.6000       | 0.1300           | 6.0580               | 75.0000           | 3495.0000                            | (28a)           |         |         |         |         |         |
| Wall - NE   | 30.7600     | 9.0600         | 21.7000       | 0.2000           | 4.3400               | 70.0000           | 1519.0000                            | (29a)           |         |         |         |         |         |
| Wall - SW   | 30.7600     | 7.0200         | 23.7400       | 0.2000           | 4.7480               | 70.0000           | 1661.8000                            | (29a)           |         |         |         |         |         |
| Wall - NW   | 38.6300     |                | 38.6300       | 0.2000           | 7.7260               | 70.0000           | 2704.1000                            | (29a)           |         |         |         |         |         |
| Roof  | 46.6000     |                | 46.6000       | 0.1100           | 5.1260               | 9.0000            | 419.4000                             | (30)            |         |         |         |         |         |
| Total net area of external elements Aum(A, m2)                      |             |                | 193.3500      |                  |                      |                   |                                      | (31)            |         |         |         |         |         |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               |                  | (26)...(30) + (32) = | 46.1027           |                                      | (33)            |         |         |         |         |         |
| Wall - SE   |             |                | 38.6300       | 0.0000           | 0.0000               | 45.0000           | 1738.3500                            | (32)            |         |         |         |         |         |
| Heat capacity Cm = Sum(A x k)                                       |             |                |               |                  |                      |                   | (28)...(30) + (32) + (32a)...(32e) = | 11537.6500 (34) |         |         |         |         |         |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                  |                      |                   |                                      | 123.7945 (35)   |         |         |         |         |         |
| List of Thermal Bridges   |             |                |               |                  |                      |                   |                                      |                 |         |         |         |         |         |
| K1 Element  |             |                |               | Length           | Psi-value            |                   | Total                                |                 |         |         |         |         |         |
| E3 Sill   |             |                |               | 10.6200          | 0.0500               |                   | 0.5310                               |                 |         |         |         |         |         |
| E4 Jamb   |             |                |               | 27.1800          | 0.0500               |                   | 1.3590                               |                 |         |         |         |         |         |
| E2 Other lintels (including other steel lintels)                    |             |                |               | 10.6200          | 0.0500               |                   | 0.5310                               |                 |         |         |         |         |         |
| E5 Ground floor (normal)  |             |                |               | 19.8300          | 0.1600               |                   | 3.1728                               |                 |         |         |         |         |         |
| E10 Eaves (insulation at ceiling level)                             |             |                |               | 12.1800          | 0.0800               |                   | 0.9744                               |                 |         |         |         |         |         |
| E12 Gable (insulation at ceiling level)                             |             |                |               | 7.6500           | 0.1200               |                   | 0.9180                               |                 |         |         |         |         |         |
| E16 Corner (normal)   |             |                |               | 10.1000          | 0.0500               |                   | 0.5050                               |                 |         |         |         |         |         |
| E18 Party wall between dwellings                                    |             |                |               | 10.1000          | 0.0400               |                   | 0.4040                               |                 |         |         |         |         |         |
| P1 Party wall - Ground floor  |             |                |               | 7.6500           | 0.1500               |                   | 1.1475                               |                 |         |         |         |         |         |
| P4 Party wall - Roof (insulation at ceiling level)                  |             |                |               | 7.6500           | 0.1100               |                   | 0.8415                               |                 |         |         |         |         |         |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |             |                |               |                  |                      |                   |                                      | 10.3842 (36)    |         |         |         |         |         |
| Point Thermal bridges   |             |                |               |                  |                      |                   | (36a) =                              | 0.0000          |         |         |         |         |         |
| Total fabric heat loss  |             |                |               |                  |                      |                   | (33) + (36) + (36a) =                | 56.4869 (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     |         |
|   | 12.6560     | 12.5662        | 12.4764       | 12.0274          | 11.9376              | 11.4887           | 11.4887                              | 11.3989         | 11.6682 | 11.9376 | 12.1172 | 12.2968 | (38)    |
| Heat transfer coeff   | 69.1429     | 69.0531        | 68.9633       | 68.5144          | 68.4246              | 67.9756           | 67.9756                              | 67.8858         | 68.1552 | 68.4246 | 68.6041 | 68.7837 | (39)    |
| Average = Sum(39)m / 12 =   |             |                |               |                  |                      |                   |                                      |                 |         |         |         |         | 68.4919 |
| HLP   | Jan         | Feb            | Mar           | Apr              | May                  | Jun               | Jul                                  | Aug             | Sep     | Oct     | Nov     | Dec     |         |
|   | 0.7419      | 0.7409         | 0.7399        | 0.7351           | 0.7342               | 0.7294            | 0.7294                               | 0.7284          | 0.7313  | 0.7342  | 0.7361  | 0.7380  | (40)    |
| HLP (average)   |             |                |               |                  |                      |                   |                                      |                 |         |         |         |         | 0.7349  |
| Days in mont  | 31          | 28             | 31            | 30               | 31                   | 30                | 31                                   | 31              | 30      | 31      | 30      | 31      |         |

# Full SAP Calculation Printout



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

|   |          |          |          |          |          |          |          |          |          |          |          |               |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Assumed occupancy   |          |          |          |          |          |          |          |          |          |          |          | 2.6670 (42)   |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |          |          | 68.6731 (42a) |
| Hot water usage for baths                                       |          |          |          |          |          |          |          |          |          |          |          | 29.6678 (42b) |
| Hot water usage for other uses                                  |          |          |          |          |          |          |          |          |          |          |          | 41.9431 (42c) |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |          | 129.2880 (43) |
|   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Daily hot water use   | 140.6488 | 137.6455 | 133.9881 | 128.4265 | 123.9102 | 119.0548 | 117.1888 | 120.8304 | 124.6711 | 129.7685 | 135.4157 | 140.2840 (44) |
| Energy content (annual)   | 222.7533 | 196.0054 | 205.9347 | 175.8095 | 166.8069 | 146.3917 | 141.7297 | 149.6133 | 153.7319 | 176.0946 | 192.9245 | 219.6509 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          | 2147.4464     |
| Water storage loss:   |          |          |          |          |          |          |          |          |          |          |          |               |
| Store volume  |          |          |          |          |          |          |          |          |          |          |          | 200.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 1.4000 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7560 (55)   |
| Total storage loss  | 23.4360  | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (56)  |
| If cylinder contains dedicated solar storage                    | 23.4360  | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (57)  |
| Primary loss  | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Combi loss  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (61)   |
| Total heat required for water heating calculated for each month | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (62) |
| WWHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63a)  |
| PV diverter   | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000 (63b) |
| Solar input   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63c)  |
| FGHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63d)  |
| Output from w/h   | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (64) |
| Electric shower(s)  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (64a)  |
| Heat gains from water heating, kWh/month                        | 111.4242 | 98.9151  | 105.8320 | 94.6103  | 92.8220  | 84.8288  | 84.4838  | 87.1051  | 87.2695  | 95.9102  | 100.3010 | 110.3926 (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   | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 40.0037   | 35.5309   | 28.8957   | 21.8759   | 16.3525   | 13.8055   | 14.9173   | 19.3900   | 26.0253   | 33.0451   | 38.5685   | 41.1155 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 365.4377  | 369.2298  | 359.6739  | 339.3303  | 313.6503  | 289.5147  | 273.3906  | 269.5985  | 279.1545  | 299.4980  | 325.1780  | 349.3137 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693 (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)                                 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 (71) |
| Water heating gains (Table 5)   | 149.7637  | 147.1952  | 142.2473  | 131.4031  | 124.7608  | 117.8178  | 113.5535  | 117.0768  | 121.2076  | 128.9115  | 139.3069  | 148.3772 (72)  |
| Total internal gains  | 662.2151  | 658.9659  | 637.8269  | 599.6194  | 561.7736  | 528.1480  | 508.8714  | 513.0753  | 533.3973  | 568.4645  | 610.0634  | 645.8164 (73)  |

## 6. Solar gains

| [Jan]       | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | g        | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W |          |          |          |          |               |
|-------------|------------|--------------------------------|------------------------------|----------|------------------------------------|------------------------------|------------|----------|----------|----------|----------|---------------|
| Northeast   | 4.6000     | 11.2829                        | 0.6200                       | 0.4000   | 0.7700                             | 8.9200 (75)                  |            |          |          |          |          |               |
| Northeast   | 1.3100     | 11.2829                        | 0.6200                       | 0.4800   | 0.7700                             | 3.0483 (75)                  |            |          |          |          |          |               |
| Southwest   | 3.9300     | 36.7938                        | 0.6200                       | 0.4800   | 0.7700                             | 29.8218 (79)                 |            |          |          |          |          |               |
| Southwest   | 3.0900     | 36.7938                        | 0.6200                       | 0.5200   | 0.7700                             | 25.4016 (79)                 |            |          |          |          |          |               |
| Northeast   | 0.7300     | 11.2829                        | 0.6200                       | 0.5300   | 0.7700                             | 1.8756 (75)                  |            |          |          |          |          |               |
| Northeast   | 0.3000     | 11.2829                        | 0.6200                       | 0.7000   | 0.7700                             | 1.0180 (75)                  |            |          |          |          |          |               |
| Solar gains | 70.0854    | 124.3179                       | 183.2096                     | 248.9839 | 298.9435                           | 305.6058                     | 290.9644   | 252.3433 | 205.7750 | 140.9332 | 84.8452  | 59.3968 (83)  |
| Total gains | 732.3005   | 783.2838                       | 821.0365                     | 848.6033 | 860.7171                           | 833.7538                     | 799.8358   | 765.4186 | 739.1723 | 709.3978 | 694.9086 | 705.2132 (84) |

## 7. Mean internal temperature (heating season)

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|   | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| 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)          |         |         |         |         |         |         |         |         |                           |         |         |              |
| tau   | 46.3519 | 46.4121 | 46.4726 | 46.7771 | 46.8385 | 47.1478 | 47.1478 | 47.2102 | 47.0236                   | 46.8385 | 46.7159 | 46.5939      |
| alpha   | 4.0901  | 4.0941  | 4.0982  | 4.1185  | 4.1226  | 4.1432  | 4.1432  | 4.1473  | 4.1349                    | 4.1226  | 4.1144  | 4.1063       |
| util living area  | 0.9370  | 0.9153  | 0.8742  | 0.7951  | 0.6688  | 0.5043  | 0.3699  | 0.4021  | 0.5967                    | 0.8060  | 0.9080  | 0.9442 (86)  |
| Living  | 19.9766 | 20.1374 | 20.3831 | 20.6622 | 20.8671 | 20.9681 | 20.9930 | 20.9901 | 20.9359                   | 20.6938 | 20.2939 | 19.9290      |
| Non living  | 19.6550 | 19.8134 | 20.0543 | 20.3259 | 20.5185 | 20.6105 | 20.6306 | 20.6290 | 20.5828                   | 20.3589 | 19.9707 | 19.6096      |
| 24 / 16   | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 24 / 9  | 3       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 16 / 9  | 28      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 10           |
| MIT   | 20.4765 | 20.1374 | 20.3831 | 20.6622 | 20.8671 | 20.9681 | 20.9930 | 20.9901 | 20.9359                   | 20.6938 | 20.2939 | 20.0788 (87) |
| Th 2  | 20.6291 | 20.6295 | 20.6300 | 20.6324 | 20.6329 | 20.6353 | 20.6353 | 20.6358 | 20.6344                   | 20.6329 | 20.6320 | 20.6310 (88) |
| util rest of house  | 0.9328  | 0.9098  | 0.8660  | 0.7822  | 0.6494  | 0.4785  | 0.3403  | 0.3716  | 0.5707                    | 0.7914  | 0.9012  | 0.9404 (89)  |
| MIT 2   | 20.1307 | 19.8134 | 20.0543 | 20.3259 | 20.5185 | 20.6105 | 20.6306 | 20.6290 | 20.5828                   | 20.3589 | 19.9707 | 19.7525 (90) |
| Living area fraction  |         |         |         |         |         |         |         |         | flA = Living area / (4) = |         |         | 0.3433 (91)  |
| MIT   | 20.2495 | 19.9246 | 20.1672 | 20.4414 | 20.6382 | 20.7332 | 20.7550 | 20.7529 | 20.7040                   | 20.4739 | 20.0817 | 19.8645 (92) |
| Temperature adjustment  |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT  | 20.2495 | 19.9246 | 20.1672 | 20.4414 | 20.6382 | 20.7332 | 20.7550 | 20.7529 | 20.7040                   | 20.4739 | 20.0817 | 19.8645 (93) |

## 8. Space heating requirement

|  | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation  | 0.9281    | 0.8981    | 0.8551   | 0.7752   | 0.6497   | 0.4855   | 0.3500   | 0.3815   | 0.5757   | 0.7847        | 0.8899   | 0.9315 (94)    |
| Useful gains   | 679.6448  | 703.5009  | 702.0336 | 657.8628 | 559.2189 | 404.7665 | 279.9815 | 291.9740 | 425.5420 | 556.6439      | 618.3804 | 656.9259 (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   | 1102.7916 | 1037.4983 | 942.5369 | 790.7482 | 611.5908 | 416.9108 | 282.4406 | 295.5032 | 450.0982 | 675.6172      | 890.5964 | 1077.4645 (97) |
| Space heating kWh  | 314.8213  | 224.4463  | 178.9345 | 95.6775  | 38.9647  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 88.5162       | 195.9955 | 312.8807 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |          |          |          |          |          |          |          |               |          | 1450.2366      |
| Solar heating kWh  | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000   | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         |           |           |          |          |          |          |          |          |          |               |          | 0.0000         |
| Space heating kWh  | 314.8213  | 224.4463  | 178.9345 | 95.6775  | 38.9647  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 88.5162       | 195.9955 | 312.8807 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |          |          |          |          |          |          |          |               |          | 1450.2366      |
| Space heating per m2   |           |           |          |          |          |          |          |          |          | (98c) / (4) = |          | 15.5605 (99)   |

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

|  |          |           |           |           |           |           |           |           |           |           |          |                 |
|--|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)  |          |           |           |           |           |           |           |           |           |           |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)   |          |           |           |           |           |           |           |           |           |           |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)   |          |           |           |           |           |           |           |           |           |           |          | 311.0195 (206)  |
| Efficiency of main space heating system 2 (in %)   |          |           |           |           |           |           |           |           |           |           |          | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %  |          |           |           |           |           |           |           |           |           |           |          | 0.0000 (208)    |
| Space heating requirement  | 314.8213 | 224.4463  | 178.9345  | 95.6775   | 38.9647   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 88.5162   | 195.9955 | 312.8807 (98)   |
| Space heating efficiency (main heating system 1)   | 311.0195 | 311.0195  | 311.0195  | 311.0195  | 311.0195  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 311.0195  | 311.0195 | 311.0195 (210)  |
| Space heating fuel (main heating system)   | 101.2224 | 72.1647   | 57.5316   | 30.7625   | 12.5281   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 28.4600   | 63.0171  | 100.5984 (211)  |
| Space heating efficiency (main heating system 2)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (212)    |
| Space heating fuel (main heating system 2)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (213)    |
| Space heating fuel (secondary)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (215)    |
| Water heating  |          |           |           |           |           |           |           |           |           |           |          |                 |
| Water heating requirement  | 269.4517 | 238.1846  | 252.6331  | 221.0015  | 213.5053  | 191.5837  | 188.4281  | 196.3117  | 198.9239  | 222.7930  | 238.1165 | 266.3493 (64)   |
| Efficiency of water heater (217)m  | 188.5207 | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207 | 188.5207 (216)  |
| Fuel for water heating, kWh/month  | 142.9295 | 126.3440  | 134.0081  | 117.2293  | 113.2530  | 101.6247  | 99.9509   | 104.1327  | 105.5183  | 118.1796  | 126.3078 | 141.2838 (219)  |
| Space cooling fuel requirement (221)m  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (221)    |
| Pumps and Fa   | 16.0935  | 14.5360   | 16.0935   | 15.5743   | 16.0935   | 15.5743   | 16.0935   | 16.0935   | 15.5743   | 16.0935   | 15.5743  | 16.0935 (231)   |
| Lighting   | 35.0150  | 28.0903   | 25.2922   | 18.5302   | 14.3132   | 11.6940   | 13.0570   | 16.9720   | 22.0449   | 28.9241   | 32.6698  | 35.9881 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)m  | -73.3425 | -123.8537 | -212.4297 | -279.3314 | -332.4171 | -319.4297 | -314.8581 | -281.8608 | -226.0268 | -157.5180 | -87.1588 | -61.0058 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m                              | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (234a)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m                  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (235a)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (235c)   |
| Electricity generated by PVs (Appendix M) (negative quantity) (233b)m  | -0.7144  | -3.1021   | -11.2975  | -29.0202  | -54.1572  | -62.5046  | -61.2709  | -43.3494  | -22.9847  | -6.9614   | -1.3840  | -0.4752 (233b)  |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m                              | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                          |          |           |           |           |           |           |           |           |           |           |          |                 |

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|  |        |        |        |        |        |        |        |        |        |        |        |            |        |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|--------|
| (235b)m  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000     | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |        |        |        |        |        |        |        |        |        |        |        |            |        |
| (235d)m  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000     | (235d) |
| Annual totals kWh/year   |        |        |        |        |        |        |        |        |        |        |        |            |        |
| Space heating fuel - main system 1   |        |        |        |        |        |        |        |        |        |        |        | 466.2848   | (211)  |
| Space heating fuel - main system 2   |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (213)  |
| Space heating fuel - secondary   |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (215)  |
| Efficiency of water heater   |        |        |        |        |        |        |        |        |        |        |        | 188.5207   |        |
| Water heating fuel used  |        |        |        |        |        |        |        |        |        |        |        | 1430.7617  | (219)  |
| Space cooling fuel   |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (221)  |
| Electricity for pumps and fans:  |        |        |        |        |        |        |        |        |        |        |        |            |        |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.1000, SFP = 0.6600)                          |        |        |        |        |        |        |        |        |        |        |        |            |        |
| mechanical ventilation fans (SFP = 0.6600)   |        |        |        |        |        |        |        |        |        |        |        | 189.4877   | (230a) |
| Total electricity for the above, kWh/year  |        |        |        |        |        |        |        |        |        |        |        | 189.4877   | (231)  |
| Electricity for lighting (calculated in Appendix L)  |        |        |        |        |        |        |        |        |        |        |        | 282.5909   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)  |        |        |        |        |        |        |        |        |        |        |        |            |        |
| PV generation  |        |        |        |        |        |        |        |        |        |        |        | -2766.4539 | (233)  |
| Wind generation  |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (234)  |
| Hydro-electric generation (Appendix N)   |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (235a) |
| Electricity generated - Micro CHP (Appendix N)   |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (235)  |
| Appendix Q - special features  |        |        |        |        |        |        |        |        |        |        |        |            |        |
| Energy saved or generated  |        |        |        |        |        |        |        |        |        |        |        | -0.0000    | (236)  |
| Energy used  |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (237)  |
| Total delivered energy for all uses  |        |        |        |        |        |        |        |        |        |        |        | -397.3288  | (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 (high-rate cost)             | 373.0278         | 17.5600             | 73.1134 (240)       |
| Space heating - main system 1 (low-rate cost)              | 93.2570          | 0.0940              | 8.7662 (240)        |
| Total CO2 associated with community systems                |                  |                     | 0.0000 (473)        |
| Water heating (electric off-peak tariff)                   |                  |                     |                     |
| High-rate fraction   |                  |                     | 0.7000 (243)        |
| Low-rate fraction  |                  |                     | 0.3000 (244)        |
| High-rate cost   | 1001.5332        | 19.6000             | 196.3005 (245)      |
| Low-rate cost  | 429.2285         | 9.4000              | 40.3475 (246)       |
| Energy for instantaneous electric shower(s)                | 0.0000           | 18.5800             | 0.0000 (247a)       |
| Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40) | 189.4877         | 18.5800             | 31.5345 (249)       |
| Energy for lighting (0.90*19.60 + 0.10*9.40)               | 282.5909         | 18.5800             | 52.5054 (250)       |
| Additional standing charges                                |                  |                     | 7.0000 (251)        |
| Energy saving/generation technologies                      |                  |                     |                     |
| PV Unit electricity used in dwelling                       | -2469.2324       | 18.5800             | -458.7834           |
| PV Unit electricity exported                               | -297.2215        | 5.5900              | -16.6147            |
| Total  |                  |                     | -475.3981 (252)     |
| Total energy cost  |                  |                     | -65.8305 (255)      |

## 11a. SAP rating - Individual heating systems

|                                  |                                  |               |
|----------------------------------|----------------------------------|---------------|
| Energy cost deflator (Table 12): |                                  | 0.3600 (256)  |
| Energy cost factor (ECF)         | [(255) x (256)] / [(4) + 45.0] = | -0.1715 (257) |
| SAP value                        |                                  | 102.7797      |
| SAP rating (Section 12)          |                                  | 103 (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 (high-rate cost) | 373.0278           | 0.1636                        | 61.0139 (261)            |
| Space heating - main system 1 (low-rate cost)  | 93.2570            | 0.1373                        | 12.8058 (261)            |
| Total CO2 associated with community systems    |                    |                               | 0.0000 (373)             |
| Water heating - high rate cost                 | 1001.5332          | 0.1479                        | 148.1638 (264)           |
| Water heating - low rate cost                  | 429.2285           | 0.1242                        | 53.2930 (264)            |
| Space and water heating                        |                    |                               | 275.2765 (265)           |
| Pumps, fans and electric keep-hot              | 189.4877           | 0.1432                        | 26.2928 (267)            |
| Energy for lighting                            | 282.5909           | 0.1490                        | 42.1116 (268)            |
| Energy saving/generation technologies          |                    |                               |                          |
| PV Unit electricity used in dwelling           | -2469.2324         | 0.1359                        | -335.5237                |
| PV Unit electricity exported                   | -297.2215          | 0.1152                        | -34.2432                 |
| Total  |                    |                               | -369.7670 (269)          |
| Total CO2, kg/year                             |                    |                               | -26.0861 (272)           |
| CO2 emissions per m2                           |                    |                               | -0.2800 (273)            |
| EI value                                       |                    |                               | 100.2529                 |
| EI rating                                      |                    |                               | 100 (274)                |
| EI band  |                    |                               | A                        |

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## CAUTION! Results should only be taken from this section for the EPC Costs

SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

### 1. Overall dwelling characteristics

|  | Area (m <sup>2</sup> ) | Storey height (m)                 | Volume (m <sup>3</sup> ) |
|--|------------------------|-----------------------------------|--------------------------|
| Ground floor   | 46.6000 (1b)           | x 2.4000 (2b)                     | = 111.8400 (1b)          |
| First floor  | 46.6000 (1c)           | x 2.6500 (2c)                     | = 123.4900 (1c)          |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | <b>93.2000</b>         |                                   | (4)                      |
| Dwelling volume  |                        | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | <b>235.3300</b> (5)      |

### 2. Ventilation rate

|  | m <sup>3</sup> per hour |
|--|-------------------------|
| Number of open chimneys                            | 0 * 80 = 0.0000 (6a)    |
| Number of open flues                               | 0 * 20 = 0.0000 (6b)    |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 (6c)    |
| Number of flues attached to solid fuel boiler      | 0 * 20 = 0.0000 (6d)    |
| Number of flues attached to other heater           | 0 * 35 = 0.0000 (6e)    |
| Number of blocked chimneys                         | 0 * 20 = 0.0000 (6f)    |
| Number of intermittent extract fans                | 0 * 10 = 0.0000 (7a)    |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                       | 0 * 40 = 0.0000 (7c)    |

|  |                             |             |
|--|-----------------------------|-------------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) =              | 0.0000 (8)  |
| Pressure test  | Yes                         |             |
| Pressure Test Method   | Blower Door                 |             |
| Measured/design AP50   |                             | 1.0000 (17) |
| Infiltration rate  |                             | 0.0500 (18) |
| Number of sides sheltered  |                             | 1 (19)      |
| Shelter factor   | (20) = 1 - [0.075 x (19)] = | 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor   | (21) = (18) x (20) =        | 0.0463 (21) |

|   | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec                  |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----------------------|
| Wind speed  | 6.0000 | 5.6000 | 5.6000 | 5.0000 | 5.0000 | 4.4000 | 4.4000 | 4.3000 | 4.7000 | 5.4000 | 5.5000 | 5.9000 (22)          |
| Wind factor   | 1.5000 | 1.4000 | 1.4000 | 1.2500 | 1.2500 | 1.1000 | 1.1000 | 1.0750 | 1.1750 | 1.3500 | 1.3750 | 1.4750 (22a)         |
| Adj infiltr rate  | 0.0694 | 0.0648 | 0.0648 | 0.0578 | 0.0578 | 0.0509 | 0.0509 | 0.0497 | 0.0543 | 0.0624 | 0.0636 | 0.0682 (22b)         |
| Balanced mechanical ventilation with heat recovery  |        |        |        |        |        |        |        |        |        |        |        |                      |
| If mechanical ventilation   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)         |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23b)         |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | <b>79.2000</b> (23c) |
| Effective ac  | 0.1734 | 0.1687 | 0.1687 | 0.1618 | 0.1618 | 0.1549 | 0.1549 | 0.1537 | 0.1583 | 0.1664 | 0.1676 | 0.1722 (25)          |

### 3. Heat losses and heat loss parameter

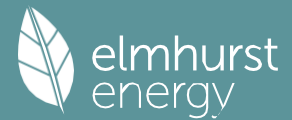
| Element   | Gross m <sup>2</sup> | Openings m <sup>2</sup> | NetArea m <sup>2</sup> | U-value W/m <sup>2</sup> K | A x U W/K | K-value kJ/m <sup>2</sup> K | A x K kJ/K      |
|---|----------------------|-------------------------|------------------------|----------------------------|-----------|-----------------------------|-----------------|
| Entrance Door   |                      |                         | 2.1200                 | 1.0000                     | 2.1200    |                             | (26)            |
| Window FF 0.40 (Uw = 1.20)                                  |                      |                         | 4.6000                 | 1.1450                     | 5.2672    |                             | (27)            |
| Window FF 0.48 (Uw = 1.20)                                  |                      |                         | 5.2400                 | 1.1450                     | 6.0000    |                             | (27)            |
| Window FF 0.52 (Uw = 1.20)                                  |                      |                         | 3.0900                 | 1.1450                     | 3.5382    |                             | (27)            |
| Window FF 0.53 (Uw = 1.20)                                  |                      |                         | 0.7300                 | 1.1450                     | 0.8359    |                             | (27)            |
| Window FF 0.70 (Uw = 1.20)                                  |                      |                         | 0.3000                 | 1.1450                     | 0.3435    |                             | (27)            |
| Ground Floor  |                      |                         | 46.6000                | 0.1300                     | 6.0580    | 75.0000                     | 3495.0000 (28a) |
| Wall - NE   | 30.7600              | 9.0600                  | 21.7000                | 0.2000                     | 4.3400    | 70.0000                     | 1519.0000 (29a) |
| Wall - SW   | 30.7600              | 7.0200                  | 23.7400                | 0.2000                     | 4.7480    | 70.0000                     | 1661.8000 (29a) |
| Wall - NW   | 38.6300              |                         | 38.6300                | 0.2000                     | 7.7260    | 70.0000                     | 2704.1000 (29a) |
| Roof  | 46.6000              |                         | 46.6000                | 0.1100                     | 5.1260    | 9.0000                      | 419.4000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                      |                         | <b>193.3500</b>        |                            |           |                             | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                      |                         |                        | (26)...(30) + (32) =       | 46.1027   |                             | (33)            |
| Wall - SE   |                      |                         | <b>38.6300</b>         | 0.0000                     | 0.0000    | 45.0000                     | 1738.3500 (32)  |

|  |                                      |                      |
|--|--------------------------------------|----------------------|
| Heat capacity Cm = Sum(A x k)                                  | (28)...(30) + (32) + (32a)...(32e) = | 11537.6500 (34)      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                                      | <b>123.7945</b> (35) |

#### List of Thermal Bridges

|  | Length  | Psi-value | Total  |
|--|---------|-----------|--------|
| K1 Element                                       | 10.6200 | 0.0500    | 0.5310 |
| E3 Sill  | 27.1800 | 0.0500    | 1.3590 |
| E4 Jamb  | 10.6200 | 0.0500    | 0.5310 |
| E2 Other lintels (including other steel lintels) | 19.8300 | 0.1600    | 3.1728 |
| E5 Ground floor (normal)                         | 12.1800 | 0.0800    | 0.9744 |
| E10 Eaves (insulation at ceiling level)          | 7.6500  | 0.1200    | 0.9180 |
| E12 Gable (insulation at ceiling level)          |         |           |        |

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|  |         |        |        |                                    |
|--|---------|--------|--------|------------------------------------|
| E16 Corner (normal)  | 10.1000 | 0.0500 | 0.5050 |                                    |
| E18 Party wall between dwellings                           | 10.1000 | 0.0400 | 0.4040 |                                    |
| P1 Party wall - Ground floor                               | 7.6500  | 0.1500 | 1.1475 |                                    |
| P4 Party wall - Roof (insulation at ceiling level)         | 7.6500  | 0.1100 | 0.8415 |                                    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |         |        |        | 10.3842 (36)                       |
| Point Thermal bridges                                      |         |        |        | 0.0000 (36a) =                     |
| Total fabric heat loss                                     |         |        |        | (33) + (36) + (36a) = 56.4869 (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          |
| Heat transfer coeff   | 13.4641 | 13.1049 | 13.1049 | 12.5662 | 12.5662 | 12.0274 | 12.0274 | 11.9376 | 12.2968 | 12.9254 | 13.0151 | 13.3743 (38) |
| Average = Sum(39)m / 12 =   | 69.9510 | 69.5919 | 69.5919 | 69.0531 | 69.0531 | 68.5144 | 68.5144 | 68.4246 | 68.7837 | 69.4123 | 69.5021 | 69.8613 (39) |
|   |         |         |         |         |         |         |         |         |         |         |         | 69.1878      |

|               |        |        |        |        |        |        |        |        |        |        |        |             |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
| HLP (average) | 0.7505 | 0.7467 | 0.7467 | 0.7409 | 0.7409 | 0.7351 | 0.7351 | 0.7342 | 0.7380 | 0.7448 | 0.7457 | 0.7496 (40) |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31          |

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

|  |         |         |         |         |         |         |         |         |         |         |         |               |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------|
| Assumed occupancy                        |         |         |         |         |         |         |         |         |         |         |         | 2.6670 (42)   |
| Hot water usage for mixer showers        | 68.9372 | 67.9012 | 66.3916 | 63.5031 | 61.3715 | 58.9944 | 57.6433 | 59.1415 | 60.7838 | 63.3361 | 66.2866 | 68.6731 (42a) |
| Hot water usage for baths                | 29.7685 | 29.3264 | 28.7038 | 27.5559 | 26.6963 | 25.7432 | 25.2284 | 25.8466 | 26.5198 | 27.5396 | 28.7112 | 29.6678 (42b) |
| Hot water usage for other uses           | 41.9431 | 40.4179 | 38.8927 | 37.3675 | 35.8423 | 34.3171 | 34.3171 | 35.8423 | 37.3675 | 38.8927 | 40.4179 | 41.9431 (42c) |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |         | 129.2880 (43) |

|  |          |          |          |          |          |          |          |          |          |          |          |               |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Energy conte                           | 140.6488 | 137.6455 | 133.9881 | 128.4265 | 123.9102 | 119.0548 | 117.1888 | 120.8304 | 124.6711 | 129.7685 | 135.4157 | 140.2840 (44) |
| Energy content (annual)                | 222.7533 | 196.0054 | 205.9347 | 175.8095 | 166.8069 | 146.3917 | 141.7297 | 149.6133 | 153.7319 | 176.0946 | 192.9245 | 219.6509 (45) |
| Distribution loss (46)m = 0.15 x (45)m | 33.4130  | 29.4008  | 30.8902  | 26.3714  | 25.0210  | 21.9588  | 21.2595  | 22.4420  | 23.0598  | 26.4142  | 28.9387  | 32.9476 (46)  |
| Total = Sum(45)m =                     |          |          |          |          |          |          |          |          |          |          |          | 2147.4464     |

#### Water storage loss:

|   |  |  |  |  |  |  |  |  |  |  |  |               |
|---|--|--|--|--|--|--|--|--|--|--|--|---------------|
| Store volume  |  |  |  |  |  |  |  |  |  |  |  | 200.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): |  |  |  |  |  |  |  |  |  |  |  | 1.4000 (48)   |
| Temperature factor from Table 2b                            |  |  |  |  |  |  |  |  |  |  |  | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                  |  |  |  |  |  |  |  |  |  |  |  | 0.7560 (55)   |

|                    |         |         |         |         |         |         |         |         |         |         |         |              |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Total storage loss | 23.4360 | 21.1680 | 23.4360 | 22.6800 | 23.4360 | 22.6800 | 23.4360 | 23.4360 | 22.6800 | 23.4360 | 22.6800 | 23.4360 (56) |
|--------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|

#### If cylinder contains dedicated solar storage

|   |          |          |          |          |          |          |          |          |          |          |          |               |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 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 (57)  |
| Combi loss  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (59)   |
| Total heat required for water heating calculated for each month | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (62) |
| WWHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63a)  |
| PV diverter   | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000 (63b) |
| Solar input   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63c)  |
| FGHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63d)  |

|  |          |          |          |          |          |          |          |          |          |          |          |                |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Output from w/h                        | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (64)  |
| Total per year (kWh/year) = Sum(64)m = |          |          |          |          |          |          |          |          |          |          |          | 2697.2824 (64) |

|  |        |        |        |        |        |        |        |        |        |        |        |              |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Electric shower(s)   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (64a) |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (64a) |

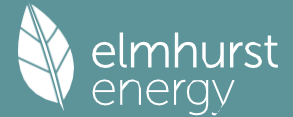
|  |          |         |          |         |         |         |         |         |         |         |          |               |
|--|----------|---------|----------|---------|---------|---------|---------|---------|---------|---------|----------|---------------|
| Heat gains from water heating, kWh/month | 111.4242 | 98.9151 | 105.8320 | 94.6103 | 92.8220 | 84.8288 | 84.4838 | 87.1051 | 87.2695 | 95.9102 | 100.3010 | 110.3926 (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   | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 40.0037   | 35.5309   | 28.8957   | 21.8759   | 16.3525   | 13.8055   | 14.9173   | 19.3900   | 26.0253   | 33.0451   | 38.5685   | 41.1155 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 365.4377  | 369.2298  | 359.6739  | 339.3303  | 313.6503  | 289.5147  | 273.3906  | 269.5985  | 279.1545  | 299.4980  | 325.1780  | 349.3137 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693 (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)                                 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 (71) |
| Water heating gains (Table 5)   | 149.7637  | 147.1952  | 142.2473  | 131.4031  | 124.7608  | 117.8178  | 113.5535  | 117.0768  | 121.2076  | 128.9115  | 139.3069  | 148.3772 (72)  |
| Total internal gains  | 662.2151  | 658.9659  | 637.8269  | 599.6194  | 561.7736  | 528.1480  | 508.8714  | 513.0753  | 533.3973  | 568.4645  | 610.0634  | 645.8164 (73)  |

#### 6. Solar gains

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| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | g | Specific data<br>or Table 6c | FF | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|------------------------------|---|------------------------------|----|------------------------------|--------------|
| Northeast | 4.6000     | 15.4538                        | 0.6200                       |   | 0.4000                       |    | 0.7700                       | 12.2174 (75) |
| Northeast | 1.3100     | 15.4538                        | 0.6200                       |   | 0.4800                       |    | 0.7700                       | 4.1752 (75)  |
| Southwest | 3.9300     | 47.2368                        | 0.6200                       |   | 0.4800                       |    | 0.7700                       | 38.2859 (79) |
| Southwest | 3.0900     | 47.2368                        | 0.6200                       |   | 0.5200                       |    | 0.7700                       | 32.6112 (79) |
| Northeast | 0.7300     | 15.4538                        | 0.6200                       |   | 0.5300                       |    | 0.7700                       | 2.5690 (75)  |
| Northeast | 0.3000     | 15.4538                        | 0.6200                       |   | 0.7000                       |    | 0.7700                       | 1.3944 (75)  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 91.2531  | 137.1943 | 203.0543 | 281.5749 | 322.4881 | 352.6879 | 310.5422 | 286.7220 | 234.8551 | 158.2364 | 106.5252 | 74.3909 (83)  |
| Total gains | 753.4682 | 796.1602 | 840.8812 | 881.1943 | 884.2616 | 880.8359 | 819.4136 | 799.7973 | 768.2524 | 726.7009 | 716.5886 | 720.2072 (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, n<sub>li,m</sub> (see Table 9a)

|                        | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| tau                    | 45.8164 | 46.0528 | 46.0528 | 46.4121 | 46.4121 | 46.7771 | 46.7771 | 46.8385 | 46.5939                   | 46.1720 | 46.1123 | 45.8753      |
| alpha                  | 4.0544  | 4.0702  | 4.0702  | 4.0941  | 4.0941  | 4.1185  | 4.1185  | 4.1226  | 4.1063                    | 4.0781  | 4.0742  | 4.0584       |
| util living area       | 0.9078  | 0.8870  | 0.8446  | 0.7673  | 0.6490  | 0.4901  | 0.3957  | 0.3964  | 0.5466                    | 0.7481  | 0.8587  | 0.9135 (86)  |
| Living                 | 20.2197 | 20.3243 | 20.5000 | 20.7122 | 20.8810 | 20.9700 | 20.9899 | 20.9901 | 20.9556                   | 20.7928 | 20.5230 | 20.2113      |
| Non living             | 19.8911 | 19.9945 | 20.1649 | 20.3704 | 20.5278 | 20.6091 | 20.6254 | 20.6260 | 20.5963                   | 20.4471 | 20.1899 | 19.8838      |
| 24 / 16                | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 24 / 9                 | 3       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 16 / 9                 | 28      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 10           |
| MIT                    | 20.6008 | 20.3243 | 20.5000 | 20.7122 | 20.8810 | 20.9700 | 20.9899 | 20.9901 | 20.9556                   | 20.7928 | 20.5230 | 20.3216 (87) |
| Th 2                   | 20.6247 | 20.6267 | 20.6267 | 20.6295 | 20.6295 | 20.6324 | 20.6324 | 20.6329 | 20.6310                   | 20.6276 | 20.6271 | 20.6252 (88) |
| util rest of house     | 0.9013  | 0.8794  | 0.8345  | 0.7532  | 0.6290  | 0.4649  | 0.3667  | 0.3668  | 0.5193                    | 0.7294  | 0.8480  | 0.9073 (89)  |
| MIT 2                  | 20.2494 | 19.9945 | 20.1649 | 20.3704 | 20.5278 | 20.6091 | 20.6254 | 20.6260 | 20.5963                   | 20.4471 | 20.1899 | 19.9875 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3433 (91)  |
| MIT                    | 20.3701 | 20.1077 | 20.2799 | 20.4877 | 20.6490 | 20.7330 | 20.7505 | 20.7510 | 20.7197                   | 20.5658 | 20.3043 | 20.1022 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT           | 20.3701 | 20.1077 | 20.2799 | 20.4877 | 20.6490 | 20.7330 | 20.7505 | 20.7510 | 20.7197                   | 20.5658 | 20.3043 | 20.1022 (93) |

## 8. Space heating requirement

|  | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation  | 0.8967   | 0.8680   | 0.8246   | 0.7476   | 0.6301   | 0.4718   | 0.3760   | 0.3764   | 0.5260   | 0.7261        | 0.8380   | 0.8977 (94)    |
| Useful gains   | 675.6266 | 691.0455 | 693.3972 | 658.7621 | 557.1689 | 415.6137 | 308.1399 | 301.0115 | 404.0630 | 527.6925      | 600.5245 | 646.5339 (95)  |
| Ext temp.  | 6.1000   | 6.4000   | 7.5000   | 9.3000   | 11.9000  | 14.5000  | 16.2000  | 16.3000  | 14.6000  | 11.8000       | 9.0000   | 6.4000 (96)    |
| Heat loss rate W   | 998.2066 | 953.9458 | 889.3806 | 772.5462 | 604.1488 | 427.0513 | 311.7760 | 304.5595 | 420.9327 | 608.4547      | 785.6696 | 957.2541 (97)  |
| Space heating kWh  | 239.9995 | 176.6690 | 145.8117 | 81.9246  | 34.9530  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 60.0870       | 133.3045 | 231.1758 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1103.9252      |
| Solar heating kWh  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000   | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         |          |          |          |          |          |          |          |          |          |               |          | 0.0000         |
| Space heating kWh  | 239.9995 | 176.6690 | 145.8117 | 81.9246  | 34.9530  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 60.0870       | 133.3045 | 231.1758 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1103.9252      |
| Space heating per m2   |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 11.8447 (99)   |

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

|   |          |          |          |          |          |          |          |          |          |          |          |                |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)   |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 310.8111 (206) |
| Efficiency of main space heating system 2 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (207)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)   |
| Space heating requirement   | 239.9995 | 176.6690 | 145.8117 | 81.9246  | 34.9530  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 60.0870  | 133.3045 | 231.1758 (98)  |
| Space heating efficiency (main heating system 1)                      | 310.8111 | 310.8111 | 310.8111 | 310.8111 | 310.8111 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 310.8111 | 310.8111 | 310.8111 (210) |
| Space heating fuel (main heating system)                              | 77.2172  | 56.8413  | 46.9133  | 26.3583  | 11.2457  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 19.3323  | 42.8892  | 74.3782 (211)  |
| Space heating efficiency (main heating system 2)                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (212)   |
| Space heating fuel (main heating system 2)                            | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (213)   |
| Space heating fuel (secondary)  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)   |
| Water heating   |          |          |          |          |          |          |          |          |          |          |          |                |
| Water heating requirement   | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (64)  |





# Full SAP Calculation Printout



Total CO2, kg/year

-94.1324 (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 (high-rate cost) | 284.1405           | 1.2876                              | 457.3177 (275)             |
| Space heating - main system 1 (low-rate cost)  | 71.0351            | 1.4969                              | 106.3302 (275)             |
| Total CO2 associated with community systems    |                    |                                     | 0.0000 (473)               |
| Water heating - high rate cost                 | 1001.4564          | 1.5530                              | 1555.2496 (278)            |
| Water heating - low rate cost                  | 429.1956           | 1.4443                              | 619.9001 (278)             |
| Space and water heating                        |                    |                                     | 2738.7976 (279)            |
| Pumps, fans and electric keep-hot              | 189.4877           | 1.5335                              | 286.6864 (281)             |
| Energy for lighting                            | 282.5909           | 1.5547                              | 439.3566 (282)             |
| Energy saving/generation technologies          |                    |                                     |                            |
| PV Unit electricity used in dwelling           | -2717.8886         | 1.5097                              | -4103.2132                 |
| PV Unit electricity exported                   | -424.2014          | 0.4204                              | -178.3405                  |
| Total  |                    |                                     | -4281.5537 (283)           |
| Total Primary energy kWh/year                  |                    |                                     | -816.7130 (286)            |

## SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: A 103  
 Current environmental impact rating: A 100

N Solar water heating Cancelled by user  
 U Solar photovoltaic panels Already installed  
 V2 Wind turbine Not applicable

| Recommended measures:<br>(none) | SAP change | Cost change | CO2 change |
|---------------------------------|------------|-------------|------------|
|                                 |            |             |            |

| Recommended measures<br>(none) | Typical annual savings |    | Energy efficiency impact | Environmental impact |
|--------------------------------|------------------------|----|--------------------------|----------------------|
|                                | Total Savings          | £0 |                          |                      |
|                                |                        |    |                          |                      |

Potential energy efficiency rating: A 103  
 Potential environmental impact rating: A 100

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):

|                                  | Current<br>£503       | Potential<br>£503     | £0                   | Saving |
|----------------------------------|-----------------------|-----------------------|----------------------|--------|
| Electricity                      |                       |                       |                      |        |
| Space heating                    | £127                  | £127                  | £0                   |        |
| Water heating                    | £308                  | £308                  | £0                   |        |
| Lighting                         | £68                   | £68                   | £0                   |        |
| Generated (PV)                   | -£679                 | -£679                 | £0                   |        |
| Total cost of fuels              | -£176                 | -£176                 | £0                   |        |
| Total cost of uses               | -£176                 | -£176                 | £0                   |        |
| Delivered energy                 | -9 kWh/m <sup>2</sup> | -9 kWh/m <sup>2</sup> | 0 kWh/m <sup>2</sup> |        |
| Carbon dioxide emissions         | -0.1 tonnes           | -0.1 tonnes           | 0.0 tonnes           |        |
| CO2 emissions per m <sup>2</sup> | -1 kg/m <sup>2</sup>  | -1 kg/m <sup>2</sup>  | 0 kg/m <sup>2</sup>  |        |
| Primary energy                   | -9 kWh/m <sup>2</sup> | -9 kWh/m <sup>2</sup> | 0 kWh/m <sup>2</sup> |        |

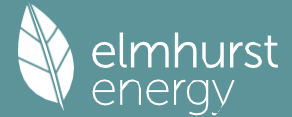
## CAUTION! Results should not be taken from this section

SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)  
 CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

|              | Area<br>(m <sup>2</sup> ) | Storey height<br>(m) | Volume<br>(m <sup>3</sup> ) |
|--------------|---------------------------|----------------------|-----------------------------|
| Ground floor | 46.6000 (1b)              | x 2.4000 (2b)        | = 111.8400 (1b) -           |

# Full SAP Calculation Printout



First floor  
 Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 93.2000 46.6000 (1c) x 2.6500 (2c) = 123.4900 (1c) - (4)  
 Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 235.3300 (5)

## 2. Ventilation rate

m3 per hour

Number of open chimneys 0 \* 80 = 0.0000 (6a)  
 Number of open flues 0 \* 20 = 0.0000 (6b)  
 Number of chimneys / flues attached to closed fire 0 \* 10 = 0.0000 (6c)  
 Number of flues attached to solid fuel boiler 0 \* 20 = 0.0000 (6d)  
 Number of flues attached to other heater 0 \* 35 = 0.0000 (6e)  
 Number of blocked chimneys 0 \* 20 = 0.0000 (6f)  
 Number of intermittent extract fans 0 \* 10 = 0.0000 (7a)  
 Number of passive vents 0 \* 10 = 0.0000 (7b)  
 Number of flueless gas fires 0 \* 40 = 0.0000 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 0.0000 / (5) = 0.0000 (8)  
 Pressure test Yes  
 Pressure Test Method Blower Door  
 Measured/design AP50 1.0000 (17)  
 Infiltration rate 0.0500 (18)  
 Number of sides sheltered 1 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.0463 (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   | 0.0590 | 0.0578 | 0.0567 | 0.0509 | 0.0497 | 0.0439 | 0.0439 | 0.0428 | 0.0463 | 0.0497 | 0.0520 | 0.0543 (22b)  |
| Balanced mechanical ventilation with heat recovery  |        |        |        |        |        |        |        |        |        |        |        |               |
| If mechanical ventilation   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23b)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 79.2000 (23c) |
| Effective ac  | 0.1630 | 0.1618 | 0.1607 | 0.1549 | 0.1537 | 0.1479 | 0.1479 | 0.1468 | 0.1502 | 0.1537 | 0.1560 | 0.1583 (25)   |

## 3. Heat losses and heat loss parameter

| Element  | Gross m2 | Openings m2 | NetArea m2           | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K      |
|--|----------|-------------|----------------------|---------------|-----------|----------------|-----------------|
| Entrance Door                                  |          |             | 2.1200               | 1.0000        | 2.1200    |                | (26)            |
| Window FF 0.40 (Uw = 1.20)                     |          |             | 4.6000               | 1.1450        | 5.2672    |                | (27)            |
| Window FF 0.48 (Uw = 1.20)                     |          |             | 5.2400               | 1.1450        | 6.0000    |                | (27)            |
| Window FF 0.52 (Uw = 1.20)                     |          |             | 3.0900               | 1.1450        | 3.5382    |                | (27)            |
| Window FF 0.53 (Uw = 1.20)                     |          |             | 0.7300               | 1.1450        | 0.8359    |                | (27)            |
| Window FF 0.70 (Uw = 1.20)                     |          |             | 0.3000               | 1.1450        | 0.3435    |                | (27)            |
| Ground Floor                                   |          |             | 46.6000              | 0.1300        | 6.0580    | 75.0000        | 3495.0000 (28a) |
| Wall - NE                                      | 30.7600  | 9.0600      | 21.7000              | 0.2000        | 4.3400    | 70.0000        | 1519.0000 (29a) |
| Wall - SW                                      | 30.7600  | 7.0200      | 23.7400              | 0.2000        | 4.7480    | 70.0000        | 1661.8000 (29a) |
| Wall - NW                                      | 38.6300  |             | 38.6300              | 0.2000        | 7.7260    | 70.0000        | 2704.1000 (29a) |
| Roof   | 46.6000  |             | 46.6000              | 0.1100        | 5.1260    | 9.0000         | 419.4000 (30)   |
| Total net area of external elements Aum(A, m2) |          |             | 193.3500             |               |           |                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)            |          |             | (26)...(30) + (32) = |               | 46.1027   |                | (33)            |
| Wall - SE                                      |          |             | 38.6300              | 0.0000        | 0.0000    | 45.0000        | 1738.3500 (32)  |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 11537.6500 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 123.7945 (35)

### List of Thermal Bridges

| K1 Element   | Length  | Psi-value | Total                              |
|--|---------|-----------|------------------------------------|
| E3 Sill  | 10.6200 | 0.0500    | 0.5310                             |
| E4 Jamb  | 27.1800 | 0.0500    | 1.3590                             |
| E2 Other lintels (including other steel lintels)           | 10.6200 | 0.0500    | 0.5310                             |
| E5 Ground floor (normal)                                   | 19.8300 | 0.1600    | 3.1728                             |
| E10 Eaves (insulation at ceiling level)                    | 12.1800 | 0.0800    | 0.9744                             |
| E12 Gable (insulation at ceiling level)                    | 7.6500  | 0.1200    | 0.9180                             |
| E16 Corner (normal)  | 10.1000 | 0.0500    | 0.5050                             |
| E18 Party wall between dwellings                           | 10.1000 | 0.0400    | 0.4040                             |
| P1 Party wall - Ground floor                               | 7.6500  | 0.1500    | 1.1475                             |
| P4 Party wall - Roof (insulation at ceiling level)         | 7.6500  | 0.1100    | 0.8415                             |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |         |           | 10.3842 (36)                       |
| Point Thermal bridges                                      |         |           | (36a) = 0.0000                     |
| Total fabric heat loss                                     |         |           | (33) + (36) + (36a) = 56.4869 (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          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Heat transfer coeff       | 12.6560 | 12.5662 | 12.4764 | 12.0274 | 11.9376 | 11.4887 | 11.4887 | 11.3989 | 11.6682 | 11.9376 | 12.1172 | 12.2968 (38) |
| Average = Sum(39)m / 12 = | 69.1429 | 69.0531 | 68.9633 | 68.5144 | 68.4246 | 67.9756 | 67.9756 | 67.8858 | 68.1552 | 68.4246 | 68.6041 | 68.7837 (39) |
|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |

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|               |        |        |        |        |        |        |        |        |        |        |        |             |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 0.7419 | 0.7409 | 0.7399 | 0.7351 | 0.7342 | 0.7294 | 0.7294 | 0.7284 | 0.7313 | 0.7342 | 0.7361 | 0.7380 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 0.7349      |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31          |

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

|   |          |          |          |          |          |          |          |          |          |          |          |   |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---|
| Assumed occupancy   |          |          |          |          |          |          |          |          |          |          |          | 2.6670 (42)   |
| Hot water usage for mixer showers                               | 68.9372  | 67.9012  | 66.3916  | 63.5031  | 61.3715  | 58.9944  | 57.6433  | 59.1415  | 60.7838  | 63.3361  | 66.2866  | 68.6731 (42a)   |
| Hot water usage for baths                                       | 29.7685  | 29.3264  | 28.7038  | 27.5559  | 26.6963  | 25.7432  | 25.2284  | 25.8466  | 26.5198  | 27.5396  | 28.7112  | 29.6678 (42b)   |
| Hot water usage for other uses                                  | 41.9431  | 40.4179  | 38.8927  | 37.3675  | 35.8423  | 34.3171  | 34.3171  | 35.8423  | 37.3675  | 38.8927  | 40.4179  | 41.9431 (42c)   |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |          | 129.2880 (43)   |
|   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec   |
| Daily hot water use   | 140.6488 | 137.6455 | 133.9881 | 128.4265 | 123.9102 | 119.0548 | 117.1888 | 120.8304 | 124.6711 | 129.7685 | 135.4157 | 140.2840 (44)   |
| Energy conte  | 222.7533 | 196.0054 | 205.9347 | 175.8095 | 166.8069 | 146.3917 | 141.7297 | 149.6133 | 153.7319 | 176.0946 | 192.9245 | 219.6509 (45)   |
| Energy content (annual)   |          |          |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = 2147.4464  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |   |
|   | 33.4130  | 29.4008  | 30.8902  | 26.3714  | 25.0210  | 21.9588  | 21.2595  | 22.4420  | 23.0598  | 26.4142  | 28.9387  | 32.9476 (46)  |
| Water storage loss:   |          |          |          |          |          |          |          |          |          |          |          |   |
| Store volume  |          |          |          |          |          |          |          |          |          |          |          | 200.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 1.4000 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7560 (55)   |
| Total storage loss  | 23.4360  | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (56)  |
| If cylinder contains dedicated solar storage                    | 23.4360  | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (57)  |
| Primary loss  | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Combi loss  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (61)   |
| Total heat required for water heating calculated for each month | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (62)   |
| WMHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63a)  |
| PV diverter   | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000 (63b)   |
| Solar input   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63c)  |
| FGHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63d)  |
| Output from w/h   | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (64)   |
|   |          |          |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m = 2697.2824 (64)                                       |
| Electric shower(s)  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (64a)  |
|   |          |          |          |          |          |          |          |          |          |          |          | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a) |
| Heat gains from water heating, kWh/month                        | 111.4242 | 98.9151  | 105.8320 | 94.6103  | 92.8220  | 84.8288  | 84.4838  | 87.1051  | 87.2695  | 95.9102  | 100.3010 | 110.3926 (65)   |

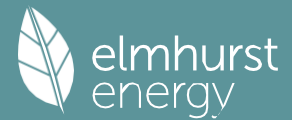
## 5. Internal gains (see Table 5 and 5a)

|   |           |           |           |           |           |           |           |           |           |           |           |                |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts  | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m   | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 40.0037   | 35.5309   | 28.8957   | 21.8759   | 16.3525   | 13.8055   | 14.9173   | 19.3900   | 26.0253   | 33.0451   | 38.5685   | 41.1155 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 365.4377  | 369.2298  | 359.6739  | 339.3303  | 313.6503  | 289.5147  | 273.3906  | 269.5985  | 279.1545  | 299.4980  | 325.1780  | 349.3137 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693 (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)                                 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 (71) |
| Water heating gains (Table 5)   | 149.7637  | 147.1952  | 142.2473  | 131.4031  | 124.7608  | 117.8178  | 113.5535  | 117.0768  | 121.2076  | 128.9115  | 139.3069  | 148.3772 (72)  |
| Total internal gains  | 662.2151  | 658.9659  | 637.8269  | 599.6194  | 561.7736  | 528.1480  | 508.8714  | 513.0753  | 533.3973  | 568.4645  | 610.0634  | 645.8164 (73)  |

## 6. Solar gains

| [Jan]       | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |          |          |          |               |
|-------------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| Northeast   | 4.6000     | 11.2829                        | 0.6200                            | 0.4000                             | 0.7700                       | 8.9200 (75)  |          |          |          |          |          |               |
| Northeast   | 1.3100     | 11.2829                        | 0.6200                            | 0.4800                             | 0.7700                       | 3.0483 (75)  |          |          |          |          |          |               |
| Southwest   | 3.9300     | 36.7938                        | 0.6200                            | 0.4800                             | 0.7700                       | 29.8218 (79) |          |          |          |          |          |               |
| Southwest   | 3.0900     | 36.7938                        | 0.6200                            | 0.5200                             | 0.7700                       | 25.4016 (79) |          |          |          |          |          |               |
| Northeast   | 0.7300     | 11.2829                        | 0.6200                            | 0.5300                             | 0.7700                       | 1.8756 (75)  |          |          |          |          |          |               |
| Northeast   | 0.3000     | 11.2829                        | 0.6200                            | 0.7000                             | 0.7700                       | 1.0180 (75)  |          |          |          |          |          |               |
| Solar gains | 70.0854    | 124.3179                       | 183.2096                          | 248.9839                           | 298.9435                     | 305.6058     | 290.9644 | 252.3433 | 205.7750 | 140.9332 | 84.8452  | 59.3968 (83)  |
| Total gains | 732.3005   | 783.2838                       | 821.0365                          | 848.6033                           | 860.7171                     | 833.7538     | 799.8358 | 765.4186 | 739.1723 | 709.3978 | 694.9086 | 705.2132 (84) |

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## 7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|   | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau   | 46.3519 | 46.4121 | 46.4726 | 46.7771 | 46.8385 | 47.1478 | 47.1478 | 47.2102 | 47.0236                   | 46.8385 | 46.7159 | 46.5939      |
| alpha   | 4.0901  | 4.0941  | 4.0982  | 4.1185  | 4.1226  | 4.1432  | 4.1432  | 4.1473  | 4.1349                    | 4.1226  | 4.1144  | 4.1063       |
| util living area  | 0.9370  | 0.9153  | 0.8742  | 0.7951  | 0.6688  | 0.5043  | 0.3699  | 0.4021  | 0.5967                    | 0.8060  | 0.9080  | 0.9442 (86)  |
| Living  | 19.9766 | 20.1374 | 20.3831 | 20.6622 | 20.8671 | 20.9681 | 20.9930 | 20.9901 | 20.9359                   | 20.6938 | 20.2939 | 19.9290      |
| Non living  | 19.6550 | 19.8134 | 20.0543 | 20.3259 | 20.5185 | 20.6105 | 20.6306 | 20.6290 | 20.5828                   | 20.3589 | 19.9707 | 19.6096      |
| 24 / 16   | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 24 / 9  | 3       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 16 / 9  | 28      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 10           |
| MIT   | 20.4765 | 20.1374 | 20.3831 | 20.6622 | 20.8671 | 20.9681 | 20.9930 | 20.9901 | 20.9359                   | 20.6938 | 20.2939 | 20.0788 (87) |
| Th 2  | 20.6291 | 20.6295 | 20.6300 | 20.6324 | 20.6329 | 20.6353 | 20.6353 | 20.6358 | 20.6344                   | 20.6329 | 20.6320 | 20.6310 (88) |
| util rest of house  | 0.9328  | 0.9098  | 0.8660  | 0.7822  | 0.6494  | 0.4785  | 0.3403  | 0.3716  | 0.5707                    | 0.7914  | 0.9012  | 0.9404 (89)  |
| MIT 2   | 20.1307 | 19.8134 | 20.0543 | 20.3259 | 20.5185 | 20.6105 | 20.6306 | 20.6290 | 20.5828                   | 20.3589 | 19.9707 | 19.7525 (90) |
| Living area fraction  |         |         |         |         |         |         |         |         | flA = Living area / (4) = |         |         | 0.3433 (91)  |
| MIT   | 20.2495 | 19.9246 | 20.1672 | 20.4414 | 20.6382 | 20.7332 | 20.7550 | 20.7529 | 20.7040                   | 20.4739 | 20.0817 | 19.8645 (92) |
| Temperature adjustment  |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT  | 20.2495 | 19.9246 | 20.1672 | 20.4414 | 20.6382 | 20.7332 | 20.7550 | 20.7529 | 20.7040                   | 20.4739 | 20.0817 | 19.8645 (93) |

## 8. Space heating requirement

|  | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation  | 0.9281    | 0.8981    | 0.8551   | 0.7752   | 0.6497   | 0.4855   | 0.3500   | 0.3815   | 0.5757   | 0.7847        | 0.8899   | 0.9315 (94)    |
| Useful gains   | 679.6448  | 703.5009  | 702.0336 | 657.8628 | 559.2189 | 404.7665 | 279.9815 | 291.9740 | 425.5420 | 556.6439      | 618.3804 | 656.9259 (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   | 1102.7916 | 1037.4983 | 942.5369 | 790.7482 | 611.5908 | 416.9108 | 282.4406 | 295.5032 | 450.0982 | 675.6172      | 890.5964 | 1077.4645 (97) |
| Space heating kWh  | 314.8213  | 224.4463  | 178.9345 | 95.6775  | 38.9647  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 88.5162       | 195.9955 | 312.8807 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |          |          |          |          |          |          |          |               |          | 1450.2366      |
| Solar heating kWh  | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000   | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         |           |           |          |          |          |          |          |          |          |               |          | 0.0000         |
| Space heating kWh  | 314.8213  | 224.4463  | 178.9345 | 95.6775  | 38.9647  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 88.5162       | 195.9955 | 312.8807 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |          |          |          |          |          |          |          |               |          | 1450.2366      |
| Space heating per m2   |           |           |          |          |          |          |          |          |          | (98c) / (4) = |          | 15.5605 (99)   |

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

|  |          |           |           |           |           |           |           |           |           |           |          |                 |
|--|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)  |          |           |           |           |           |           |           |           |           |           |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)   |          |           |           |           |           |           |           |           |           |           |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)   |          |           |           |           |           |           |           |           |           |           |          | 311.0195 (206)  |
| Efficiency of main space heating system 2 (in %)   |          |           |           |           |           |           |           |           |           |           |          | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %  |          |           |           |           |           |           |           |           |           |           |          | 0.0000 (208)    |
| Space heating requirement  | 314.8213 | 224.4463  | 178.9345  | 95.6775   | 38.9647   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 88.5162   | 195.9955 | 312.8807 (98)   |
| Space heating efficiency (main heating system 1)   | 311.0195 | 311.0195  | 311.0195  | 311.0195  | 311.0195  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 311.0195  | 311.0195 | 311.0195 (210)  |
| Space heating fuel (main heating system)   | 101.2224 | 72.1647   | 57.5316   | 30.7625   | 12.5281   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 28.4600   | 63.0171  | 100.5984 (211)  |
| Space heating efficiency (main heating system 2)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (212)    |
| Space heating fuel (main heating system 2)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (213)    |
| Space heating fuel (secondary)   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (215)    |
| Water heating  |          |           |           |           |           |           |           |           |           |           |          |                 |
| Water heating requirement  | 269.4517 | 238.1846  | 252.6331  | 221.0015  | 213.5053  | 191.5837  | 188.4281  | 196.3117  | 198.9239  | 222.7930  | 238.1165 | 266.3493 (64)   |
| Efficiency of water heater (217)m  | 188.5207 | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207  | 188.5207 | 188.5207 (216)  |
| Fuel for water heating, kWh/month  | 142.9295 | 126.3440  | 134.0081  | 117.2293  | 113.2530  | 101.6247  | 99.9509   | 104.1327  | 105.5183  | 118.1796  | 126.3078 | 141.2838 (219)  |
| Space cooling fuel requirement (221)m  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (221)    |
| Pumps and Fa   | 16.0935  | 14.5360   | 16.0935   | 15.5743   | 16.0935   | 15.5743   | 16.0935   | 16.0935   | 15.5743   | 16.0935   | 15.5743  | 16.0935 (231)   |
| Lighting   | 35.0150  | 28.0903   | 25.2922   | 18.5302   | 14.3132   | 11.6940   | 13.0570   | 16.9720   | 22.0449   | 28.9241   | 32.6698  | 35.9881 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)m  | -73.3425 | -123.8537 | -212.4297 | -279.3314 | -332.4171 | -319.4297 | -314.8581 | -281.8608 | -226.0268 | -157.5180 | -87.1588 | -61.0058 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m                              | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (234a)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m                  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (235a)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000 (235c)   |

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|  |         |         |          |          |          |          |          |          |          |         |         |         |                  |
|--|---------|---------|----------|----------|----------|----------|----------|----------|----------|---------|---------|---------|------------------|
| Electricity generated by PVs (Appendix M) (negative quantity)  |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| (233b)m  | -0.7144 | -3.1021 | -11.2975 | -29.0202 | -54.1572 | -62.5046 | -61.2709 | -43.3494 | -22.9847 | -6.9614 | -1.3840 | -0.4752 | (233b)           |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| (234b)m  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | (234b)           |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| (235b)m  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | (235b)           |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| (235d)m  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | (235d)           |
| Annual totals kWh/year   |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| Space heating fuel - main system 1   |         |         |          |          |          |          |          |          |          |         |         |         | 466.2848 (211)   |
| Space heating fuel - main system 2   |         |         |          |          |          |          |          |          |          |         |         |         | 0.0000 (213)     |
| Space heating fuel - secondary   |         |         |          |          |          |          |          |          |          |         |         |         | 0.0000 (215)     |
| Efficiency of water heater   |         |         |          |          |          |          |          |          |          |         |         |         | 188.5207         |
| Water heating fuel used  |         |         |          |          |          |          |          |          |          |         |         |         | 1430.7617 (219)  |
| Space cooling fuel   |         |         |          |          |          |          |          |          |          |         |         |         | 0.0000 (221)     |
| Electricity for pumps and fans:  |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.1000, SFP = 0.6600)                          |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| mechanical ventilation fans (SFP = 0.6600)   |         |         |          |          |          |          |          |          |          |         |         |         | 189.4877 (230a)  |
| Total electricity for the above, kWh/year  |         |         |          |          |          |          |          |          |          |         |         |         | 189.4877 (231)   |
| Electricity for lighting (calculated in Appendix L)  |         |         |          |          |          |          |          |          |          |         |         |         | 282.5909 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)  |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| PV generation  |         |         |          |          |          |          |          |          |          |         |         |         | -2766.4539 (233) |
| Wind generation  |         |         |          |          |          |          |          |          |          |         |         |         | 0.0000 (234)     |
| Hydro-electric generation (Appendix N)   |         |         |          |          |          |          |          |          |          |         |         |         | 0.0000 (235a)    |
| Electricity generated - Micro CHP (Appendix N)   |         |         |          |          |          |          |          |          |          |         |         |         | 0.0000 (235)     |
| Appendix Q - special features  |         |         |          |          |          |          |          |          |          |         |         |         |                  |
| Energy saved or generated  |         |         |          |          |          |          |          |          |          |         |         |         | -0.0000 (236)    |
| Energy used  |         |         |          |          |          |          |          |          |          |         |         |         | 0.0000 (237)     |
| Total delivered energy for all uses  |         |         |          |          |          |          |          |          |          |         |         |         | -397.3288 (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 (high-rate cost)             | 373.0278         | 17.5600             | 73.1134 (240)       |
| Space heating - main system 1 (low-rate cost)              | 93.2570          | 0.0940              | 8.7662 (240)        |
| Total CO2 associated with community systems                |                  |                     | 0.0000 (473)        |
| Water heating (electric off-peak tariff)                   |                  |                     | 0.7000 (243)        |
| High-rate fraction   |                  |                     | 0.3000 (244)        |
| Low-rate fraction  |                  |                     | 0.0000 (244)        |
| High-rate cost   | 1001.5332        | 19.6000             | 196.3005 (245)      |
| Low-rate cost  | 429.2285         | 9.4000              | 40.3475 (246)       |
| Energy for instantaneous electric shower(s)                | 0.0000           | 18.5800             | 0.0000 (247a)       |
| Pumps, fans and electric keep-hot (0.90*19.60 + 0.10*9.40) | 189.4877         | 18.5800             | 31.5345 (249)       |
| Energy for lighting (0.90*19.60 + 0.10*9.40)               | 282.5909         | 18.5800             | 52.5054 (250)       |
| Additional standing charges                                |                  |                     | 7.0000 (251)        |
| Energy saving/generation technologies                      |                  |                     |                     |
| PV Unit electricity used in dwelling                       | -2469.2324       | 18.5800             | -458.7834           |
| PV Unit electricity exported                               | -297.2215        | 5.5900              | -16.6147            |
| Total  |                  |                     | -475.3981 (252)     |
| Total energy cost  |                  |                     | -65.8305 (255)      |

## 11a. SAP rating - Individual heating systems

|                                  |                                  |               |
|----------------------------------|----------------------------------|---------------|
| Energy cost deflator (Table 12): |                                  | 0.3600 (256)  |
| Energy cost factor (ECF)         | [(255) x (256)] / [(4) + 45.0] = | -0.1715 (257) |
| SAP value                        |                                  | 102.7797      |
| SAP rating (Section 12)          |                                  | 103 (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 (high-rate cost) | 373.0278           | 0.1636                        | 61.0139 (261)            |
| Space heating - main system 1 (low-rate cost)  | 93.2570            | 0.1373                        | 12.8058 (261)            |
| Total CO2 associated with community systems    |                    |                               | 0.0000 (373)             |
| Water heating - high rate cost                 | 1001.5332          | 0.1479                        | 148.1638 (264)           |
| Water heating - low rate cost                  | 429.2285           | 0.1242                        | 53.2930 (264)            |
| Space and water heating                        |                    |                               | 275.2765 (265)           |
| Pumps, fans and electric keep-hot              | 189.4877           | 0.1432                        | 26.2928 (267)            |
| Energy for lighting                            | 282.5909           | 0.1490                        | 42.1116 (268)            |
| Energy saving/generation technologies          |                    |                               |                          |
| PV Unit electricity used in dwelling           | -2469.2324         | 0.1359                        | -335.5237                |
| PV Unit electricity exported                   | -297.2215          | 0.1152                        | -34.2432                 |
| Total  |                    |                               | -369.7670 (269)          |
| Total CO2, kg/year                             |                    |                               | -26.0861 (272)           |
| CO2 emissions per m2                           |                    |                               | -0.2800 (273)            |
| EI value                                       |                    |                               | 100.2529                 |
| EI rating                                      |                    |                               | 100 (274)                |
| EI band  |                    |                               | A                        |

## CAUTION! Results should not be taken from this section

SAP 10 WORKSHEET FOR New Build (As Built) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

### 1. Overall dwelling characteristics

|  | Area<br>(m2) | Storey height<br>(m)            | Volume<br>(m3)  |
|--|--------------|---------------------------------|-----------------|
| Ground floor   | 46.6000 (1b) | x 2.4000 (2b)                   | = 111.8400 (1b) |
| First floor  | 46.6000 (1c) | x 2.6500 (2c)                   | = 123.4900 (1c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.2000      |                                 |                 |
| Dwelling volume  |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 235.3300 (5)  |

### 2. Ventilation rate

|  | m3 per hour          |
|--|----------------------|
| Number of open chimneys                            | 0 * 80 = 0.0000 (6a) |
| Number of open flues                               | 0 * 20 = 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 (6c) |
| Number of flues attached to solid fuel boiler      | 0 * 20 = 0.0000 (6d) |
| Number of flues attached to other heater           | 0 * 35 = 0.0000 (6e) |
| Number of blocked chimneys                         | 0 * 20 = 0.0000 (6f) |
| Number of intermittent extract fans                | 0 * 10 = 0.0000 (7a) |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b) |
| Number of flueless gas fires                       | 0 * 40 = 0.0000 (7c) |

|  |                             |             |
|--|-----------------------------|-------------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) =              | 0.0000 (8)  |
| Pressure test  |                             | Yes         |
| Pressure Test Method   |                             | Blower Door |
| Measured/design AP50   |                             | 1.0000 (17) |
| Infiltration rate  |                             | 0.0500 (18) |
| Number of sides sheltered  |                             | 1 (19)      |
| Shelter factor   | (20) = 1 - [0.075 x (19)] = | 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor   | (21) = (18) x (20) =        | 0.0463 (21) |

|   | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed  | 6.0000 | 5.6000 | 5.6000 | 5.0000 | 5.0000 | 4.4000 | 4.4000 | 4.3000 | 4.7000 | 5.4000 | 5.5000 | 5.9000        |
| Wind factor   | 1.5000 | 1.4000 | 1.4000 | 1.2500 | 1.2500 | 1.1000 | 1.1000 | 1.0750 | 1.1750 | 1.3500 | 1.3750 | 1.4750        |
| Adj infilt rate   | 0.0694 | 0.0648 | 0.0648 | 0.0578 | 0.0578 | 0.0509 | 0.0509 | 0.0497 | 0.0543 | 0.0624 | 0.0636 | 0.0682        |
| Balanced mechanical ventilation with heat recovery  |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (22b)  |
| If mechanical ventilation   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23b)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 79.2000 (23c) |
| Effective ac  | 0.1734 | 0.1687 | 0.1687 | 0.1618 | 0.1618 | 0.1549 | 0.1549 | 0.1537 | 0.1583 | 0.1664 | 0.1676 | 0.1722 (25)   |

### 3. Heat losses and heat loss parameter

| Element  | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K   |
|--|-------------|----------------|---------------|----------------------|--------------|-------------------|-----------------|
| Entrance Door                                  |             |                | 2.1200        | 1.0000               | 2.1200       |                   | (26)            |
| Window FF 0.40 (Uw = 1.20)                     |             |                | 4.6000        | 1.1450               | 5.2672       |                   | (27)            |
| Window FF 0.48 (Uw = 1.20)                     |             |                | 5.2400        | 1.1450               | 6.0000       |                   | (27)            |
| Window FF 0.52 (Uw = 1.20)                     |             |                | 3.0900        | 1.1450               | 3.5382       |                   | (27)            |
| Window FF 0.53 (Uw = 1.20)                     |             |                | 0.7300        | 1.1450               | 0.8359       |                   | (27)            |
| Window FF 0.70 (Uw = 1.20)                     |             |                | 0.3000        | 1.1450               | 0.3435       |                   | (27)            |
| Ground Floor                                   |             |                | 46.6000       | 0.1300               | 6.0580       | 75.0000           | 3495.0000 (28a) |
| Wall - NE                                      | 30.7600     | 9.0600         | 21.7000       | 0.2000               | 4.3400       | 70.0000           | 1519.0000 (29a) |
| Wall - SW                                      | 30.7600     | 7.0200         | 23.7400       | 0.2000               | 4.7480       | 70.0000           | 1661.8000 (29a) |
| Wall - NW                                      | 38.6300     |                | 38.6300       | 0.2000               | 7.7260       | 70.0000           | 2704.1000 (29a) |
| Roof   | 46.6000     |                | 46.6000       | 0.1100               | 5.1260       | 9.0000            | 419.4000 (30)   |
| Total net area of external elements Aum(A, m2) |             |                | 193.3500      |                      |              |                   | (31)            |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               | (26)...(30) + (32) = | 46.1027      |                   | (33)            |
| Wall - SE                                      |             |                | 38.6300       | 0.0000               | 0.0000       | 45.0000           | 1738.3500 (32)  |

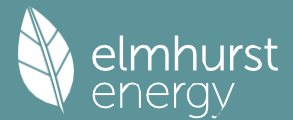
|   |                                      |                 |
|---|--------------------------------------|-----------------|
| Heat capacity Cm = Sum(A x k)                     | (28)...(30) + (32) + (32a)...(32e) = | 11537.6500 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K |                                      | 123.7945 (35)   |

#### List of Thermal Bridges

| K1 Element | Length  | Psi-value | Total  |
|------------|---------|-----------|--------|
| E3 Sill    | 10.6200 | 0.0500    | 0.5310 |



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|   |         |         |         |         |         |         |         |                                    |         |         |         |              |
|---|---------|---------|---------|---------|---------|---------|---------|------------------------------------|---------|---------|---------|--------------|
| E4 Jamb   |         |         |         |         |         | 27.1800 | 0.0500  | 1.3590                             |         |         |         |              |
| E2 Other lintels (including other steel lintels)                    |         |         |         |         |         | 10.6200 | 0.0500  | 0.5310                             |         |         |         |              |
| E5 Ground floor (normal)  |         |         |         |         |         | 19.8300 | 0.1600  | 3.1728                             |         |         |         |              |
| E10 Eaves (insulation at ceiling level)                             |         |         |         |         |         | 12.1800 | 0.0800  | 0.9744                             |         |         |         |              |
| E12 Gable (insulation at ceiling level)                             |         |         |         |         |         | 7.6500  | 0.1200  | 0.9180                             |         |         |         |              |
| E16 Corner (normal)   |         |         |         |         |         | 10.1000 | 0.0500  | 0.5050                             |         |         |         |              |
| E18 Party wall between dwellings                                    |         |         |         |         |         | 10.1000 | 0.0400  | 0.4040                             |         |         |         |              |
| P1 Party wall - Ground floor  |         |         |         |         |         | 7.6500  | 0.1500  | 1.1475                             |         |         |         |              |
| P4 Party wall - Roof (insulation at ceiling level)                  |         |         |         |         |         | 7.6500  | 0.1100  | 0.8415                             |         |         |         |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |         |         |         |         |         |         |         | 10.3842 (36)                       |         |         |         |              |
| Point Thermal bridges   |         |         |         |         |         |         |         | (36a) = 0.0000                     |         |         |         |              |
| Total fabric heat loss  |         |         |         |         |         |         |         | (33) + (36) + (36a) = 56.4869 (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          |
| Heat transfer coeff   | 13.4641 | 13.1049 | 13.1049 | 12.5662 | 12.5662 | 12.0274 | 12.0274 | 11.9376                            | 12.2968 | 12.9254 | 13.0151 | 13.3743 (38) |
| Average = Sum(39)m / 12 =   | 69.9510 | 69.5919 | 69.5919 | 69.0531 | 69.0531 | 68.5144 | 68.5144 | 68.4246                            | 68.7837 | 69.4123 | 69.5021 | 69.8613 (39) |
| HLP   | 0.7505  | 0.7467  | 0.7467  | 0.7409  | 0.7409  | 0.7351  | 0.7351  | 0.7342                             | 0.7380  | 0.7448  | 0.7457  | 0.7496 (40)  |
| HLP (average)   |         |         |         |         |         |         |         |                                    |         |         |         | 0.7424       |
| Days in mont  | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31                                 | 30      | 31      | 30      | 31           |

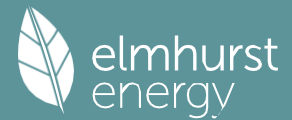
## 4. Water heating energy requirements (kWh/year)

|   |          |          |          |          |          |          |          |          |          |          |          |               |   |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|---|
| Assumed occupancy   |          |          |          |          |          |          |          |          |          |          |          |               | 2.6670 (42)   |
| Hot water usage for mixer showers                               | 68.9372  | 67.9012  | 66.3916  | 63.5031  | 61.3715  | 58.9944  | 57.6433  | 59.1415  | 60.7838  | 63.3361  | 66.2866  | 68.6731 (42a) |   |
| Hot water usage for baths                                       | 29.7685  | 29.3264  | 28.7038  | 27.5559  | 26.6963  | 25.7432  | 25.2284  | 25.8466  | 26.5198  | 27.5396  | 28.7112  | 29.6678 (42b) |   |
| Hot water usage for other uses                                  | 41.9431  | 40.4179  | 38.8927  | 37.3675  | 35.8423  | 34.3171  | 34.3171  | 35.8423  | 37.3675  | 38.8927  | 40.4179  | 41.9431 (42c) |   |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |          |               | 129.2880 (43)   |
| Daily hot water use   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |   |
| Energy conte  | 140.6488 | 137.6455 | 133.9881 | 128.4265 | 123.9102 | 119.0548 | 117.1888 | 120.8304 | 124.6711 | 129.7685 | 135.4157 | 140.2840 (44) |   |
| Energy content (annual)   | 222.7533 | 196.0054 | 205.9347 | 175.8095 | 166.8069 | 146.3917 | 141.7297 | 149.6133 | 153.7319 | 176.0946 | 192.9245 | 219.6509 (45) |   |
| Distribution loss (46)m = 0.15 x (45)m                          | 33.4130  | 29.4008  | 30.8902  | 26.3714  | 25.0210  | 21.9588  | 21.2595  | 22.4420  | 23.0598  | 26.4142  | 28.9387  | 32.9476 (46)  |   |
| Water storage loss:   |          |          |          |          |          |          |          |          |          |          |          |               | 200.0000 (47)   |
| Store volume  |          |          |          |          |          |          |          |          |          |          |          |               | 1.4000 (48)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          |               | 0.5400 (49)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          |               | 0.7560 (55)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          |               |   |
| Total storage loss  | 23.4360  | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (56)  |   |
| If cylinder contains dedicated solar storage                    | 23.4360  | 21.1680  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360  | 23.4360  | 22.6800  | 23.4360  | 22.6800  | 23.4360 (57)  |   |
| Primary loss  | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |   |
| Combi loss  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (61)   |   |
| Total heat required for water heating calculated for each month | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (62) |   |
| WMHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63a)  |   |
| PV diverter   | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000 (63b) |   |
| Solar input   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63c)  |   |
| FGHRS   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63d)  |   |
| Output from w/h   | 269.4517 | 238.1846 | 252.6331 | 221.0015 | 213.5053 | 191.5837 | 188.4281 | 196.3117 | 198.9239 | 222.7930 | 238.1165 | 266.3493 (64) |   |
|   |          |          |          |          |          |          |          |          |          |          |          |               | Total per year (kWh/year) = Sum(64)m = 2697.2824 (64)                                       |
| Electric shower(s)  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (64a)  |   |
|   |          |          |          |          |          |          |          |          |          |          |          |               | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a) |
| Heat gains from water heating, kWh/month                        | 111.4242 | 98.9151  | 105.8320 | 94.6103  | 92.8220  | 84.8288  | 84.4838  | 87.1051  | 87.2695  | 95.9102  | 100.3010 | 110.3926 (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   | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222  | 160.0222 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 40.0037   | 35.5309   | 28.8957   | 21.8759   | 16.3525   | 13.8055   | 14.9173   | 19.3900   | 26.0253   | 33.0451   | 38.5685   | 41.1155 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 365.4377  | 369.2298  | 359.6739  | 339.3303  | 313.6503  | 289.5147  | 273.3906  | 269.5985  | 279.1545  | 299.4980  | 325.1780  | 349.3137 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693   | 53.6693 (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)                                 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 | -106.6815 (71) |
| Water heating gains (Table 5)   | 149.7637  | 147.1952  | 142.2473  | 131.4031  | 124.7608  | 117.8178  | 113.5535  | 117.0768  | 121.2076  | 128.9115  | 139.3069  | 148.3772 (72)  |
| Total internal gains  | 662.2151  | 658.9659  | 637.8269  | 599.6194  | 561.7736  | 528.1480  | 508.8714  | 513.0753  | 533.3973  | 568.4645  | 610.0634  | 645.8164 (73)  |

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## 6. Solar gains

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 4.6000     | 15.4538                        | 0.6200                            | 0.4000                             | 0.7700                       | 12.2174 (75) |
| Northeast | 1.3100     | 15.4538                        | 0.6200                            | 0.4800                             | 0.7700                       | 4.1752 (75)  |
| Southwest | 3.9300     | 47.2368                        | 0.6200                            | 0.4800                             | 0.7700                       | 38.2859 (79) |
| Southwest | 3.0900     | 47.2368                        | 0.6200                            | 0.5200                             | 0.7700                       | 32.6112 (79) |
| Northeast | 0.7300     | 15.4538                        | 0.6200                            | 0.5300                             | 0.7700                       | 2.5690 (75)  |
| Northeast | 0.3000     | 15.4538                        | 0.6200                            | 0.7000                             | 0.7700                       | 1.3944 (75)  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 91.2531  | 137.1943 | 203.0543 | 281.5749 | 322.4881 | 352.6879 | 310.5422 | 286.7220 | 234.8551 | 158.2364 | 106.5252 | 74.3909 (83)  |
| Total gains | 753.4682 | 796.1602 | 840.8812 | 881.1943 | 884.2616 | 880.8359 | 819.4136 | 799.7973 | 768.2524 | 726.7009 | 716.5886 | 720.2072 (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, n1,m (see Table 9a)

|                        | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| tau                    | 45.8164 | 46.0528 | 46.0528 | 46.4121 | 46.4121 | 46.7771 | 46.7771 | 46.8385 | 46.5939                   | 46.1720 | 46.1123 | 45.8753      |
| alpha                  | 4.0544  | 4.0702  | 4.0702  | 4.0941  | 4.0941  | 4.1185  | 4.1185  | 4.1226  | 4.1063                    | 4.0781  | 4.0742  | 4.0584       |
| util living area       | 0.9078  | 0.8870  | 0.8446  | 0.7673  | 0.6490  | 0.4901  | 0.3957  | 0.3964  | 0.5466                    | 0.7481  | 0.8587  | 0.9135 (86)  |
| Living                 | 20.2197 | 20.3243 | 20.5000 | 20.7122 | 20.8810 | 20.9700 | 20.9899 | 20.9901 | 20.9556                   | 20.7928 | 20.5230 | 20.2113      |
| Non living             | 19.8911 | 19.9945 | 20.1649 | 20.3704 | 20.5278 | 20.6091 | 20.6254 | 20.6260 | 20.5963                   | 20.4471 | 20.1899 | 19.8838      |
| 24 / 16                | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 24 / 9                 | 3       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 16 / 9                 | 28      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 10           |
| MIT                    | 20.6008 | 20.3243 | 20.5000 | 20.7122 | 20.8810 | 20.9700 | 20.9899 | 20.9901 | 20.9556                   | 20.7928 | 20.5230 | 20.3216 (87) |
| Th 2                   | 20.6247 | 20.6267 | 20.6267 | 20.6295 | 20.6295 | 20.6324 | 20.6324 | 20.6329 | 20.6310                   | 20.6276 | 20.6271 | 20.6252 (88) |
| util rest of house     | 0.9013  | 0.8794  | 0.8345  | 0.7532  | 0.6290  | 0.4649  | 0.3667  | 0.3668  | 0.5193                    | 0.7294  | 0.8480  | 0.9073 (89)  |
| MIT 2                  | 20.2494 | 19.9945 | 20.1649 | 20.3704 | 20.5278 | 20.6091 | 20.6254 | 20.6260 | 20.5963                   | 20.4471 | 20.1899 | 19.9875 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3433 (91)  |
| MIT                    | 20.3701 | 20.1077 | 20.2799 | 20.4877 | 20.6490 | 20.7330 | 20.7505 | 20.7510 | 20.7197                   | 20.5658 | 20.3043 | 20.1022 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT           | 20.3701 | 20.1077 | 20.2799 | 20.4877 | 20.6490 | 20.7330 | 20.7505 | 20.7510 | 20.7197                   | 20.5658 | 20.3043 | 20.1022 (93) |

## 8. Space heating requirement

|  | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation  | 0.8967   | 0.8680   | 0.8246   | 0.7476   | 0.6301   | 0.4718   | 0.3760   | 0.3764   | 0.5260   | 0.7261        | 0.8380   | 0.8977 (94)    |
| Useful gains   | 675.6266 | 691.0455 | 693.3972 | 658.7621 | 557.1689 | 415.6137 | 308.1399 | 301.0115 | 404.0630 | 527.6925      | 600.5245 | 646.5339 (95)  |
| Ext temp.  | 6.1000   | 6.4000   | 7.5000   | 9.3000   | 11.9000  | 14.5000  | 16.2000  | 16.3000  | 14.6000  | 11.8000       | 9.0000   | 6.4000 (96)    |
| Heat loss rate W   | 998.2066 | 953.9458 | 889.3806 | 772.5462 | 604.1488 | 427.0513 | 311.7760 | 304.5595 | 420.9327 | 608.4547      | 785.6696 | 957.2541 (97)  |
| Space heating kWh  | 239.9995 | 176.6690 | 145.8117 | 81.9246  | 34.9530  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 60.0870       | 133.3045 | 231.1758 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1103.9252      |
| Solar heating kWh  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000   | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         |          |          |          |          |          |          |          |          |          |               |          | 0.0000         |
| Space heating kWh  | 239.9995 | 176.6690 | 145.8117 | 81.9246  | 34.9530  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 60.0870       | 133.3045 | 231.1758 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1103.9252      |
| Space heating per m2   |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 11.8447 (99)   |

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

|   | Jan      | Feb      | Mar      | Apr      | May      | Jun    | Jul    | Aug    | Sep    | Oct      | Nov      | Dec            |
|---|----------|----------|----------|----------|----------|--------|--------|--------|--------|----------|----------|----------------|
| 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 %)                      |          |          |          |          |          |        |        |        |        |          |          | 310.8111 (206) |
| Efficiency of main space heating system 2 (in %)                      |          |          |          |          |          |        |        |        |        |          |          | 0.0000 (207)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |        |        |        |        |          |          | 0.0000 (208)   |
| Space heating requirement   | 239.9995 | 176.6690 | 145.8117 | 81.9246  | 34.9530  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 60.0870  | 133.3045 | 231.1758 (98)  |
| Space heating efficiency (main heating system 1)                      | 310.8111 | 310.8111 | 310.8111 | 310.8111 | 310.8111 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 310.8111 | 310.8111 | 310.8111 (210) |
| Space heating fuel (main heating system)                              | 77.2172  | 56.8413  | 46.9133  | 26.3583  | 11.2457  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.3323  | 42.8892  | 74.3782 (211)  |
| Space heating efficiency (main heating system 2)                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000   | 0.0000   | 0.0000 (212)   |
| Space heating fuel (main heating system 2)                            | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000   | 0.0000   | 0.0000 (213)   |
| Space heating fuel (secondary)  |          |          |          |          |          |        |        |        |        |          |          |                |

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|   |          |           |           |           |           |           |           |           |           |           |           |          |          |          |                  |
|---|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|------------------|
|   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (215)            |
| Water heating requirement   | 269.4517 | 238.1846  | 252.6331  | 221.0015  | 213.5053  | 191.5837  | 188.4281  | 196.3117  | 198.9239  | 222.7930  | 238.1165  | 266.3493 | 266.3493 | 266.3493 | (64)             |
| Efficiency of water heater (217)m   | 188.5352 | 188.5352  | 188.5352  | 188.5352  | 188.5352  | 188.5352  | 188.5352  | 188.5352  | 188.5352  | 188.5352  | 188.5352  | 188.5352 | 188.5352 | 188.5352 | (216)            |
| Fuel for water heating, kWh/month   | 142.9185 | 126.3343  | 133.9978  | 117.2203  | 113.2443  | 101.6170  | 99.9432   | 104.1247  | 105.5102  | 118.1705  | 126.2982  | 141.2730 | 141.2730 | 141.2730 | (219)            |
| Space cooling fuel requirement (221)m   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (221)            |
| Pumps and Fans  | 16.0935  | 14.5360   | 16.0935   | 15.5743   | 16.0935   | 15.5743   | 16.0935   | 16.0935   | 15.5743   | 16.0935   | 15.5743   | 16.0935  | 16.0935  | 16.0935  | (231)            |
| Lighting  | 35.0150  | 28.0903   | 25.2922   | 18.5302   | 14.3132   | 11.6940   | 13.0570   | 16.9720   | 22.0449   | 28.9241   | 32.6698   | 35.9881  | 35.9881  | 35.9881  | (232)            |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)m   | -97.5111 | -139.1445 | -236.6421 | -311.2418 | -352.3057 | -324.3311 | -320.5763 | -312.2194 | -255.5414 | -178.7680 | -111.4249 | -78.1824 | -78.1824 | -78.1824 | (233a)           |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (234a)           |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (235a)           |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (235c)           |
| Electricity generated by PVs (Appendix M) (negative quantity) (233b)m   | -1.4958  | -4.2939   | -15.2825  | -39.4933  | -64.4702  | -115.2916 | -80.1337  | -58.3045  | -32.0288  | -9.8414   | -2.6508   | -0.9148  | -0.9148  | -0.9148  | (233b)           |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (234b)           |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (235b)           |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m  | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | (235d)           |
| Annual totals kWh/year  |          |           |           |           |           |           |           |           |           |           |           |          |          |          |                  |
| Space heating fuel - main system 1  |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 355.1756 (211)   |
| Space heating fuel - main system 2  |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 0.0000 (213)     |
| Space heating fuel - secondary  |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 0.0000 (215)     |
| Efficiency of water heater  |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 188.5352         |
| Water heating fuel used   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 1430.6520 (219)  |
| Space cooling fuel  |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 0.0000 (221)     |
| Electricity for pumps and fans:<br>(Balanced with Heat Recovery, DataSheet: in-use factor = 1.1000, SFP = 0.6600)<br>mechanical ventilation fans (SFP = 0.6600) |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 189.4877 (230a)  |
| Total electricity for the above, kWh/year   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 189.4877 (231)   |
| Electricity for lighting (calculated in Appendix L)   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 282.5909 (232)   |
| Energy saving/generation technologies (Appendices M, N and Q)   |          |           |           |           |           |           |           |           |           |           |           |          |          |          |                  |
| PV generation   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | -3142.0900 (233) |
| Wind generation   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 0.0000 (234)     |
| Hydro-electric generation (Appendix N)  |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 0.0000 (235a)    |
| Electricity generated - Micro CHP (Appendix N)  |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 0.0000 (235)     |
| Appendix Q - special features   |          |           |           |           |           |           |           |           |           |           |           |          |          |          |                  |
| Energy saved or generated   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | -0.0000 (236)    |
| Energy used   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | 0.0000 (237)     |
| Total delivered energy for all uses   |          |           |           |           |           |           |           |           |           |           |           |          |          |          | -884.1838 (238)  |

## 10a. Fuel costs - using BEDF prices (526)

|   | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---|------------------|---------------------|---------------------|
| Space heating - main system 1 (high-rate cost)              | 284.1405         | 22.8200             | 72.1717 (240)       |
| Space heating - main system 1 (low-rate cost)               | 71.0351          | 0.1250              | 8.8794 (240)        |
| Total CO2 associated with community systems                 |                  |                     | 0.0000 (473)        |
| Water heating (electric off-peak tariff)                    |                  |                     |                     |
| High-rate fraction  |                  |                     | 0.7000 (243)        |
| Low-rate fraction   |                  |                     | 0.3000 (244)        |
| High-rate cost  | 1001.4564        | 25.4000             | 254.3699 (245)      |
| Low-rate cost   | 429.1956         | 12.5000             | 53.6494 (246)       |
| Energy for instantaneous electric shower(s)                 | 0.0000           | 24.1100             | 0.0000 (247a)       |
| Pumps, fans and electric keep-hot (0.90*25.40 + 0.10*12.50) | 189.4877         | 24.1100             | 41.0411 (249)       |
| Energy for lighting (0.90*25.40 + 0.10*12.50)               | 282.5909         | 24.1100             | 68.1327 (250)       |
| Additional standing charges                                 |                  |                     | 5.0000 (251)        |
| Energy saving/generation technologies                       |                  |                     |                     |
| PV Unit electricity used in dwelling                        | -2717.8886       | 24.1100             | -655.2829           |
| PV Unit electricity exported                                | -424.2014        | 5.5900              | -23.7129            |
| Total   |                  |                     | -678.9958 (252)     |
| Total energy cost   |                  |                     | -175.7515 (255)     |

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

|  | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1 (high-rate cost) | 284.1405           | 0.1635                        | 46.4575 (261)            |
| Space heating - main system 1 (low-rate cost)  | 71.0351            | 0.1373                        | 9.7500 (261)             |
| Total CO2 associated with community systems    |                    |                               | 0.0000 (373)             |
| Water heating - high rate cost                 | 1001.4564          | 0.1479                        | 148.1524 (264)           |
| Water heating - low rate cost                  | 429.1956           | 0.1242                        | 53.2890 (264)            |
| Space and water heating                        |                    |                               | 257.6489 (265)           |
| Pumps, fans and electric keep-hot              | 189.4877           | 0.1432                        | 26.2928 (267)            |
| Energy for lighting                            | 282.5909           | 0.1490                        | 42.1116 (268)            |

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|                                       |            |        |                 |
|---------------------------------------|------------|--------|-----------------|
| Energy saving/generation technologies |            |        |                 |
| PV Unit electricity used in dwelling  | -2717.8886 | 0.1367 | -371.5182       |
| PV Unit electricity exported          | -424.2014  | 0.1147 | -48.6676        |
| Total                                 |            |        | -420.1858 (269) |
| Total CO2, kg/year                    |            |        | -94.1324 (272)  |

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 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 (high-rate cost) | 284.1405           | 1.2876                              | 457.3177 (275)             |
| Space heating - main system 1 (low-rate cost)  | 71.0351            | 1.4969                              | 106.3302 (275)             |
| Total CO2 associated with community systems    |                    |                                     | 0.0000 (473)               |
| Water heating - high rate cost                 | 1001.4564          | 1.5530                              | 1555.2496 (278)            |
| Water heating - low rate cost                  | 429.1956           | 1.4443                              | 619.9001 (278)             |
| Space and water heating                        |                    |                                     | 2738.7976 (279)            |
| Pumps, fans and electric keep-hot              | 189.4877           | 1.5335                              | 286.6864 (281)             |
| Energy for lighting                            | 282.5909           | 1.5547                              | 439.3566 (282)             |
| Energy saving/generation technologies          |                    |                                     |                            |
| PV Unit electricity used in dwelling           | -2717.8886         | 1.5097                              | -4103.2132                 |
| PV Unit electricity exported                   | -424.2014          | 0.4204                              | -178.3405                  |
| Total  |                    |                                     | -4281.5537 (283)           |
| Total Primary energy kWh/year                  |                    |                                     | -816.7130 (286)            |