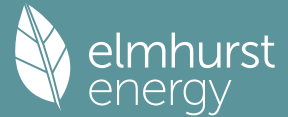


# Full SAP Calculation Printout



|                                    |                        |               |       |      |                |            |
|------------------------------------|------------------------|---------------|-------|------|----------------|------------|
| Property Reference                 | 2708 2B4P              |               |       |      | Issued on Date | 22/11/2024 |
| Assessment Reference               | Fabric                 | Prop Type Ref |       |      |                |            |
| Property                           | B2009 2B4P,            |               |       |      |                |            |
|                                    |                        |               |       |      |                |            |
| SAP Rating                         | 83 B                   | DER           | 9.00  | TER  | 11.71          |            |
| Environmental                      | 93 A                   | % DER < TER   |       |      |                | 23.14      |
| CO <sub>2</sub> Emissions (t/year) | 0.65                   | DFEE          | 27.88 | TFEE | 35.54          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |      |                | 21.55      |
| % DPER < TPER                      | 4.16                   | DPER          | 58.78 | TPER | 61.33          |            |
|                                    |                        |               |       |      |                |            |
| Assessor Details                   | Mr. Michael Woodbridge |               |       |      | Assessor ID    | M818-0001  |
| Client                             |                        |               |       |      |                |            |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 39.7000 (1b)              | x 2.5000 (2b)                   | = 99.2500 (1b) - (3b)       |
| First floor                                            | 39.7000 (1c)              | x 2.6000 (2c)                   | = 103.2200 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 202.4700 (5)              |

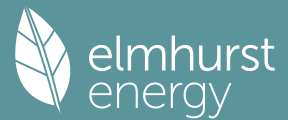
## 2. Ventilation rate

|                                                                                                         | 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                                                                                    | 4.0000 (17)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate                                                                                       | 0.2000 (18)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Number of sides sheltered                                                                               | 3 (19)                                                                          |            |            |            |            |            |            |            |            |            |            |                 |
| Shelter factor                                                                                          | (20) = 1 - [0.075 x (19)] = 0.7750 (20)                                         |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate adjusted to include shelter factor                                                    | (21) = (18) x (20) = 0.1550 (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                                                                                         | 0.1976                                                                          | 0.1938     | 0.1899     | 0.1705     | 0.1666     | 0.1473     | 0.1473     | 0.1434     | 0.1550     | 0.1666     | 0.1744     | 0.1821 (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) =            |                                                                                 |            |            |            |            |            |            |            |            |            |            | 70.3800 (23c)   |
| Effective ac                                                                                            | 0.3457                                                                          | 0.3419     | 0.3380     | 0.3186     | 0.3147     | 0.2954     | 0.2954     | 0.2915     | 0.3031     | 0.3147     | 0.3225     | 0.3302 (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   |
|--------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| W1 (Uw = 0.80)                                               |                         |                            | 2.6400                    | 0.7752                        | 2.0465       |                                | (27)            |
| W2 (Uw = 0.80)                                               |                         |                            | 1.4400                    | 0.7752                        | 1.1163       |                                | (27)            |
| W3 (Uw = 0.80)                                               |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| W4 (Uw = 0.80)                                               |                         |                            | 2.3800                    | 0.7752                        | 1.8450       |                                | (27)            |
| W5 (Uw = 0.80)                                               |                         |                            | 1.2000                    | 0.7752                        | 0.9302       |                                | (27)            |
| W6 (Uw = 0.80)                                               |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| Front Door                                                   |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26)            |
| Rear door                                                    |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26a)           |
| Ground floor                                                 |                         |                            | 39.7000                   | 0.1200                        | 4.7640       | 110.0000                       | 4367.0000 (28a) |
| External Walls                                               | 93.1260                 | 13.2400                    | 79.8860                   | 0.1500                        | 11.9829      | 9.0000                         | 718.9740 (29a)  |
| Roof at ceiling                                              | 39.7000                 |                            | 39.7000                   | 0.1100                        | 4.3670       | 9.0000                         | 357.3000 (30)   |
| Total net area of external elements Aum (A, m <sup>2</sup> ) |                         |                            | 172.5260                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                          |                         |                            | (26)...(30) + (32) =      |                               | 32.3891      |                                | (33)            |
| Party Walls                                                  |                         |                            | 38.6070                   | 0.0000                        | 0.0000       | 45.0000                        | 1737.3149 (32)  |

# Full SAP Calculation Printout



|                  |          |         |                 |
|------------------|----------|---------|-----------------|
| Internal Walls   | 141.6180 | 9.0000  | 1274.5620 (32c) |
| Internal floor   | 39.7000  | 18.0000 | 714.6000 (32d)  |
| Internal ceiling | 39.7000  | 9.0000  | 357.3000 (32e)  |

Heat capacity  $C_m = \text{Sum}(A \times k)$  (28)...(30) + (32) + (32a)...(32e) = 9527.0509 (34)  
 Thermal mass parameter (TMP =  $C_m / \text{TFA}$ ) in kJ/m<sup>2</sup>K 119.9880 (35)

| List of Thermal Bridges                                                   | Length  | Psi-value           | Total        |
|---------------------------------------------------------------------------|---------|---------------------|--------------|
| K1 Element                                                                | 9.8600  | 0.0540              | 0.5324       |
| E2 Other lintels (including other steel lintels)                          | 7.7200  | 0.0400              | 0.3088       |
| E3 Sill                                                                   | 23.9000 | 0.0240              | 0.5736       |
| E4 Jamb                                                                   | 0.0000  | 0.0630              | 0.0000       |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.1000              | 0.0000       |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.0600              | 0.0000       |
| E14 Flat roof                                                             | 10.2000 | 0.0400              | 0.4080       |
| E16 Corner (normal)                                                       | 0.0000  | -0.0630             | -0.0000      |
| E17 Corner (inverted - internal area greater than external area)          | 10.2000 | 0.0490              | 0.4998       |
| E18 Party wall between dwellings                                          | 0.0000  | 0.0570              | 0.0000       |
| E25 Staggered party wall between dwellings                                | 18.2400 | 0.0550              | 1.0032       |
| E5 Ground floor (normal)                                                  | 18.2400 | 0.0250              | 0.4560       |
| E6 Intermediate floor within a dwelling                                   | 18.2400 | 0.0420              | 0.7661       |
| E10 Eaves (insulation at ceiling level)                                   | 0.0000  | 0.0000              | 0.0000       |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 7.5500  | 0.0340              | 0.2567       |
| P4 Party wall - Roof (insulation at ceiling level)                        | 7.5500  | 0.3200              | 2.4160       |
| P1 Party wall - Ground floor                                              | 7.5500  | 0.0000              | 0.0000       |
| P2 Party wall - Intermediate floor within a dwelling                      |         |                     |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |                     | 7.2206 (36)  |
| Point Thermal bridges                                                     |         |                     | 0.0000 (36a) |
| Total fabric heat loss                                                    |         | (33) + (36) + (36a) | 39.6097 (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                                                 | 23.0997 | 22.8407 | 22.5818 | 21.2873 | 21.0284 | 19.7338 | 19.7338 | 19.4749 | 20.2517 | 21.0284 | 21.5462 | 22.0640 (38) |
| Average = Sum(39)m / 12 =                                           | 62.7094 | 62.4505 | 62.1915 | 60.8970 | 60.6381 | 59.3436 | 59.3436 | 59.0846 | 59.8614 | 60.6381 | 61.1559 | 61.6737 (39) |
|                                                                     |         |         |         |         |         |         |         |         |         |         |         | 60.8323      |
| HLP                                                                 | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 0.7898  | 0.7865  | 0.7833  | 0.7670  | 0.7637  | 0.7474  | 0.7474  | 0.7441  | 0.7539  | 0.7637  | 0.7702  | 0.7767 (40)  |
| Days in mont                                                        | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31           |

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

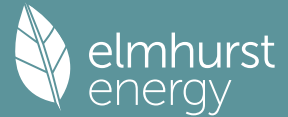
|                                                                                |          |          |          |         |         |         |         |         |         |         |          |                              |
|--------------------------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|------------------------------|
| Assumed occupancy                                                              |          |          |          |         |         |         |         |         |         |         |          | 2.4514 (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                                                      | 28.2135  | 27.7945  | 27.2044  | 26.1165 | 25.3018 | 24.3985 | 23.9106 | 24.4965 | 25.1345 | 26.1011 | 27.2114  | 28.1181 (42b)                |
| Hot water usage for other uses                                                 | 39.7346  | 38.2897  | 36.8448  | 35.3999 | 33.9550 | 32.5101 | 32.5101 | 33.9550 | 35.3999 | 36.8448 | 38.2897  | 39.7346 (42c)                |
| Average daily hot water use (litres/day)                                       |          |          |          |         |         |         |         |         |         |         |          | 62.2807 (43)                 |
| Daily hot water use                                                            | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov      | Dec                          |
| Energy conte                                                                   | 67.9481  | 66.0842  | 64.0492  | 61.5164 | 59.2568 | 56.9086 | 56.4207 | 58.4515 | 60.5344 | 62.9458 | 65.5011  | 67.8527 (44)                 |
| Energy content (annual)                                                        | 107.6131 | 94.1030  | 98.4413  | 84.2128 | 79.7711 | 69.9758 | 68.2359 | 72.3752 | 74.6449 | 85.4169 | 93.3183  | 106.2409 (45)                |
| Distribution loss (46)m = 0.15 x (45)m                                         |          |          |          |         |         |         |         |         |         |         |          | Total = Sum(45)m = 1034.3493 |
| Water storage loss:                                                            | 16.1420  | 14.1154  | 14.7662  | 12.6319 | 11.9657 | 10.4964 | 10.2354 | 10.8563 | 11.1967 | 12.8125 | 13.9977  | 15.9361 (46)                 |
| 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                                                                     | 13.9321  | 12.5745  | 13.9079  | 13.4371 | 13.8700 | 13.4084 | 13.8490 | 13.8581 | 13.4212 | 13.8856 | 13.4595  | 13.9296 (61)                 |
| Total heat required for water heating calculated for each month                | 121.5452 | 106.6775 | 112.3491 | 97.6500 | 93.6411 | 83.3842 | 82.0849 | 86.2333 | 88.0662 | 99.3025 | 106.7778 | 120.1705 (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                                                                | 121.5452 | 106.6775 | 112.3491 | 97.6500 | 93.6411 | 83.3842 | 82.0849 | 86.2333 | 88.0662 | 99.3025 | 106.7778 | 120.1705 (64)                |
| 12Total per year (kWh/year)                                                    |          |          |          |         |         |         |         |         |         |         |          | 1197.8822 (64)               |
| Electric shower(s)                                                             | 52.3114  | 46.6099  | 50.8963  | 48.5697 | 49.4811 | 47.2001 | 48.7735 | 49.4811 | 48.5697 | 50.8963 | 49.9392  | 52.3114 (64a)                |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |         |         |         |         |         |         |         |          | 595.0396 (64a)               |
| Heat gains from water heating, kWh/month                                       | 52.3422  | 46.0853  | 48.9328  | 43.5025 | 42.3617 | 38.4191 | 38.3441 | 39.8995 | 40.3172 | 44.5966 | 46.8780  | 51.8854 (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                                                                               | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 124.4886 | 137.8267 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 218.1820 | 220.4460 | 214.7407 | 202.5947 | 187.2627 | 172.8527 | 163.2259 | 160.9618 | 166.6672 | 178.8131 | 194.1452 | 208.5552 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569 (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   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 (71) |
| Water heating gains (Table 5)                                                       | 70.3525  | 68.5794  | 65.7698  | 60.4201  | 56.9377  | 53.3598  | 51.5377  | 53.6284  | 55.9961  | 59.9417  | 65.1084  | 69.7384 (72)  |
| Total internal gains                                                                | 475.7938 | 489.6228 | 467.7698 | 454.4238 | 431.4597 | 414.6214 | 399.0229 | 398.8496 | 411.0722 | 426.0141 | 450.6625 | 465.5529 (73) |

## 6. Solar gains

# Full SAP Calculation Printout



| [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   |  |
|-------|------------|--|--------------------------------|--|-----------------------------------|--|------------------------------------|--|------------------------------|--|--------------|--|
| South | 2.6400     |  | 46.7521                        |  | 0.6300                            |  | 0.0000                             |  | 0.7700                       |  | 59.8737 (78) |  |
| South | 1.4400     |  | 46.7521                        |  | 0.6300                            |  | 0.0000                             |  | 0.7700                       |  | 32.6584 (78) |  |
| South | 0.5400     |  | 46.7521                        |  | 0.6300                            |  | 0.0000                             |  | 0.7700                       |  | 12.2469 (78) |  |
| North | 2.3800     |  | 10.6334                        |  | 0.6300                            |  | 0.0000                             |  | 0.7700                       |  | 12.2767 (74) |  |
| North | 1.2000     |  | 10.6334                        |  | 0.6300                            |  | 0.0000                             |  | 0.7700                       |  | 6.1899 (74)  |  |
| West  | 0.5400     |  | 19.6403                        |  | 0.6300                            |  | 0.0000                             |  | 0.7700                       |  | 5.1448 (80)  |  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 128.3904 | 216.9559 | 295.1311 | 367.5491 | 416.8254 | 416.9893 | 400.6320 | 362.7770 | 319.7193 | 239.0388 | 153.3947 | 110.1642 (83) |
| Total gains | 604.1841 | 706.5787 | 762.9009 | 821.9729 | 848.2851 | 831.6107 | 799.6549 | 761.6265 | 730.7914 | 665.0528 | 604.0572 | 575.7171 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 42.2011                   | 42.3760 | 42.5525 | 43.4570 | 43.6426 | 44.5946 | 44.5946 | 44.7900 | 44.2089 | 43.6426 | 43.2731 | 42.9097      |
| alpha                                                                       | 3.8134                    | 3.8251  | 3.8368  | 3.8971  | 3.9095  | 3.9730  | 3.9730  | 3.9860  | 3.9473  | 3.9095  | 3.8849  | 3.8606       |
| util living area                                                            | 0.9441                    | 0.9057  | 0.8538  | 0.7502  | 0.6126  | 0.4454  | 0.3239  | 0.3531  | 0.5377  | 0.7746  | 0.9054  | 0.9512 (86)  |
| MIT                                                                         | 19.7697                   | 20.0559 | 20.3525 | 20.6873 | 20.8847 | 20.9755 | 20.9946 | 20.9924 | 20.9475 | 20.6994 | 20.2125 | 19.7339 (87) |
| Th 2                                                                        | 20.2622                   | 20.2650 | 20.2679 | 20.2821 | 20.2849 | 20.2992 | 20.2992 | 20.3020 | 20.2934 | 20.2849 | 20.2792 | 20.2735 (88) |
| util rest of house                                                          | 0.9366                    | 0.8940  | 0.8364  | 0.7231  | 0.5750  | 0.3998  | 0.2733  | 0.3009  | 0.4895  | 0.7441  | 0.8919  | 0.9446 (89)  |
| MIT 2                                                                       | 18.8217                   | 19.1783 | 19.5439 | 19.9525 | 20.1753 | 20.2800 | 20.2960 | 20.2974 | 20.2499 | 19.9761 | 19.3883 | 18.7853 (90) |
| Living area fraction                                                        | FLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.9996                   | 19.3430 | 19.6956 | 20.0904 | 20.3085 | 20.4105 | 20.4271 | 20.4278 | 20.3808 | 20.1118 | 19.5430 | 18.9633 (92) |
| Temperature adjustment                                                      |                           |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 18.8496                   | 19.1930 | 19.5456 | 19.9404 | 20.1585 | 20.2605 | 20.2771 | 20.2778 | 20.2308 | 19.9618 | 19.3930 | 18.8133 (93) |

## 8. Space heating requirement

|                                                                                |               |          |          |          |          |          |          |          |          |          |          |                |
|--------------------------------------------------------------------------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
|                                                                                | Jan           | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Utilisation                                                                    | 0.9187        | 0.8739   | 0.8169   | 0.7093   | 0.5681   | 0.3973   | 0.2717   | 0.2991   | 0.4851   | 0.7290   | 0.8721   | 0.9278 (94)    |
| Useful gains                                                                   | 555.0451      | 617.5043 | 623.2324 | 583.0127 | 481.9187 | 330.3930 | 217.2991 | 227.7812 | 354.5355 | 484.8405 | 526.7805 | 534.1532 (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                                                               | 912.3967      | 892.6054 | 811.3272 | 672.3255 | 512.9045 | 335.9166 | 218.2118 | 229.1188 | 366.9983 | 567.6840 | 751.7892 | 901.2560 (97)  |
| Space heating kWh                                                              | 265.8696      | 184.8679 | 139.9425 | 64.3052  | 23.0534  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 61.6356  | 162.0063 | 273.1245 (98a) |
| Space heating requirement - total per year (kWh/year)                          |               |          |          |          |          |          |          |          |          |          |          | 1174.8051      |
| 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                                                              | 265.8696      | 184.8679 | 139.9425 | 64.3052  | 23.0534  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 61.6356  | 162.0063 | 273.1245 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |               |          |          |          |          |          |          |          |          |          |          | 1174.8051      |
| Space heating per m2                                                           | (98c) / (4) = |          |          |          |          |          |          |          |          |          |          |                |
|                                                                                | 14.7960 (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 %)                                                             |          |          |          |          |          |         |         |         |          |          |          | 89.0000 (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                                                                                    | 265.8696 | 184.8679 | 139.9425 | 64.3052  | 23.0534  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 61.6356  | 162.0063 | 273.1245 (98)  |
| Space heating efficiency (main heating system 1)                                                             | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 89.0000  | 89.0000  | 89.0000 (210)  |
| Space heating fuel (main heating system)                                                                     | 298.7299 | 207.7168 | 157.2388 | 72.2531  | 25.9027  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 69.2535  | 182.0295 | 306.8814 (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                                                                                    | 121.5452 | 106.6775 | 112.3491 | 97.6500  | 93.6411  | 83.3842 | 82.0849 | 86.2333 | 88.0662  | 99.3025  | 106.7778 | 120.1705 (64)  |
| Efficiency of water heater (217)m                                                                            | 88.4596  | 88.3703  | 88.2349  | 87.9672  | 87.6307  | 87.3000 | 87.3000 | 87.3000 | 87.3000  | 87.9433  | 88.3168  | 87.3000 (216)  |
| Fuel for water heating, kWh/month                                                                            | 137.4020 | 120.7164 | 127.3297 | 111.0073 | 106.8588 | 95.5145 | 94.0262 | 98.7781 | 100.8776 | 112.9165 | 120.9032 | 135.8264 (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                                                                                                 | 20.4161  | 18.4404  | 20.4161  | 19.7575  | 20.4161  | 19.7575 | 20.4161 | 20.4161 | 19.7575  | 20.4161  | 19.7575  | 20.4161 (231)  |
| Lighting                                                                                                     | 30.0194  | 24.0827  | 21.6838  | 15.8865  | 12.2712  | 10.0256 | 11.1942 | 14.5506 | 18.8998  | 24.7975  | 28.0088  | 30.8537 (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)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 (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                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000 (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)                          |          |          |          |          |          |         |         |         |          |          |          |                |

# Full SAP Calculation Printout



|                                                                                                      |        |        |        |        |        |        |        |        |        |        |        |           |        |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| (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                                                                   |        |        |        |        |        |        |        |        |        |        |        | 1320.0057 | (211)  |
| Space heating fuel - main system 2                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (213)  |
| Space heating fuel - secondary                                                                       |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (215)  |
| Efficiency of water heater                                                                           |        |        |        |        |        |        |        |        |        |        |        | 87.3000   |        |
| Water heating fuel used                                                                              |        |        |        |        |        |        |        |        |        |        |        | 1362.1567 | (219)  |
| Space cooling fuel                                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (221)  |
| Electricity for pumps and fans:                                                                      |        |        |        |        |        |        |        |        |        |        |        |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)                           |        |        |        |        |        |        |        |        |        |        |        |           |        |
| mechanical ventilation fans (SFP = 0.6250)                                                           |        |        |        |        |        |        |        |        |        |        |        | 154.3834  | (230a) |
| central heating pump                                                                                 |        |        |        |        |        |        |        |        |        |        |        | 41.0000   | (230c) |
| main heating flue fan                                                                                |        |        |        |        |        |        |        |        |        |        |        | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                                                            |        |        |        |        |        |        |        |        |        |        |        | 240.3834  | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                  |        |        |        |        |        |        |        |        |        |        |        | 242.2737  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |        |        |        |        |        |        |        |        |        |        |        |           |        |
| PV generation                                                                                        |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (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                                                                  |        |        |        |        |        |        |        |        |        |        |        | 3759.8590 | (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                   | 1320.0057          | 0.2100                        | 277.2012                 | (261)  |
| Total CO2 associated with community systems     |                    |                               | 0.0000                   | (373)  |
| Water heating (other fuel)                      | 1362.1567          | 0.2100                        | 286.0529                 | (264)  |
| Energy for instantaneous electric shower(s)     | 595.0396           | 0.1391                        | 82.7832                  | (264a) |
| Space and water heating                         |                    |                               | 563.2541                 | (265)  |
| Pumps, fans and electric keep-hot               | 240.3834           | 0.1387                        | 33.3441                  | (267)  |
| Energy for lighting                             | 242.2737           | 0.1443                        | 34.9676                  | (268)  |
| Total CO2, kg/year                              |                    |                               | 714.3490                 | (272)  |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 9.0000                   | (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               | 1320.0057          | 1.1300                              | 1491.6064                  | (275)  |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473)  |
| Water heating (other fuel)                  | 1362.1567          | 1.1300                              | 1539.2370                  | (278)  |
| Energy for instantaneous electric shower(s) | 595.0396           | 1.5143                              | 901.0888                   | (278a) |
| Space and water heating                     |                    |                                     | 3030.8434                  | (279)  |
| Pumps, fans and electric keep-hot           | 240.3834           | 1.5128                              | 363.6520                   | (281)  |
| Energy for lighting                         | 242.2737           | 1.5338                              | 371.6075                   | (282)  |
| Total Primary energy kWh/year               |                    |                                     | 4667.1917                  | (286)  |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 58.7800                    | (287)  |

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

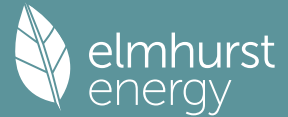
### 1. Overall dwelling characteristics

|                                                         | Area<br>(m2) | Storey height<br>(m)              | Volume<br>(m3)         |  |
|---------------------------------------------------------|--------------|-----------------------------------|------------------------|--|
| Ground floor                                            | 39.7000 (1b) | x 2.5000 (2b)                     | = 99.2500 (1b) - (3b)  |  |
| First floor                                             | 39.7000 (1c) | x 2.6000 (2c)                     | = 103.2200 (1c) - (3c) |  |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)... (1n) | 79.4000      |                                   | (4)                    |  |
| Dwelling volume                                         |              | (3a)+(3b)+(3c)+(3d)+(3e) ... (3n) | = 202.4700 (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) = | 0.1482 (8)   |
| Pressure test                                                                                      | Yes             |              |
| Pressure Test Method                                                                               | Blower Door     |              |
| Measured/design AP50                                                                               | 5.0000          | (17)         |
| Infiltration rate                                                                                  | 0.3982          | (18)         |
| Number of sides sheltered                                                                          | 3               | (19)         |

# Full SAP Calculation Printout



Shelter factor  
Infiltration rate adjusted to include shelter factor

$$(20) = 1 - [0.075 \times (19)] = 0.7750 \quad (20)$$

$$(21) = (18) \times (20) = 0.3086 \quad (21)$$

|                 | 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 | 0.3934 | 0.3857 | 0.3780 | 0.3394 | 0.3317 | 0.2932 | 0.2932 | 0.2854 | 0.3086 | 0.3317 | 0.3472 | 0.3626 | (22b) |
| Effective ac    | 0.5774 | 0.5744 | 0.5714 | 0.5576 | 0.5550 | 0.5430 | 0.5430 | 0.5407 | 0.5476 | 0.5550 | 0.5603 | 0.5657 | (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                                   |             |                | 2.2500        | 1.0000               | 2.2500       |                   |               | (26)  |
| TER Semi-glazed door                              |             |                | 2.2500        | 1.0000               | 2.2500       |                   |               | (26a) |
| TER Opening Type (Uw = 1.20)                      |             |                | 8.7400        | 1.1450               | 10.0076      |                   |               | (27)  |
| Ground floor                                      |             |                | 39.7000       | 0.1300               | 5.1610       |                   |               | (28a) |
| External Walls                                    | 93.1260     | 13.2400        | 79.8860       | 0.1800               | 14.3795      |                   |               | (29a) |
| Roof at ceiling                                   | 39.7000     |                | 39.7000       | 0.1100               | 4.3670       |                   |               | (30)  |
| Total net area of external elements Aum(A, m2)    |             |                | 172.5260      |                      |              |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)               |             |                |               | (26)...(30) + (32) = | 38.4151      |                   |               | (33)  |
| Party Walls                                       |             |                | 38.6070       | 0.0000               | 0.0000       |                   |               | (32)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K |             |                |               |                      |              |                   | 119.9880      | (35)  |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

List of Thermal Bridges

|                                                                           | Length  | Psi-value | Total                 |              |
|---------------------------------------------------------------------------|---------|-----------|-----------------------|--------------|
| K1 Element                                                                | 9.8600  | 0.0500    | 0.4930                |              |
| E2 Other lintels (including other steel lintels)                          | 7.7200  | 0.0500    | 0.3860                |              |
| E3 Sill                                                                   | 23.9000 | 0.0500    | 1.1950                |              |
| E4 Jamb                                                                   | 0.0000  | 0.0700    | 0.0000                |              |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0000    | 0.0000                |              |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.0000    | 0.0000                |              |
| E14 Flat roof                                                             | 0.0000  | 0.0800    | 0.0000                |              |
| E16 Corner (normal)                                                       | 10.2000 | 0.0900    | 0.9180                |              |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000  | -0.0900   | -0.0000               |              |
| E18 Party wall between dwellings                                          | 10.2000 | 0.0600    | 0.6120                |              |
| E25 Staggered party wall between dwellings                                | 0.0000  | 0.0600    | 0.0000                |              |
| E5 Ground floor (normal)                                                  | 18.2400 | 0.1600    | 2.9184                |              |
| E6 Intermediate floor within a dwelling                                   | 18.2400 | 0.0000    | 0.0000                |              |
| E10 Eaves (insulation at ceiling level)                                   | 18.2400 | 0.0600    | 1.0944                |              |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000                |              |
| P4 Party wall - Roof (insulation at ceiling level)                        | 7.5500  | 0.1200    | 0.9060                |              |
| P1 Party wall - Ground floor                                              | 7.5500  | 0.0800    | 0.6040                |              |
| P2 Party wall - Intermediate floor within a dwelling                      | 7.5500  | 0.0000    | 0.0000                |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |           | 9.1268                | (36)         |
| Point Thermal bridges                                                     |         |           | 0.0000                | (36a) =      |
| Total fabric heat loss                                                    |         |           | (33) + (36) + (36a) = | 47.5419 (37) |

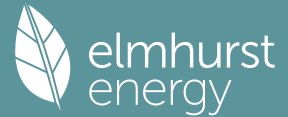
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |      |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| (38)m                     | 38.5789 | 38.3781 | 38.1813 | 37.2568 | 37.0838 | 36.2785 | 36.2785 | 36.1294 | 36.5887 | 37.0838 | 37.4337 | 37.7995 | (38) |
| Heat transfer coeff       | 86.1208 | 85.9200 | 85.7232 | 84.7987 | 84.6257 | 83.8205 | 83.8205 | 83.6713 | 84.1306 | 84.6257 | 84.9756 | 85.3415 | (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 84.7978 |      |
| HLP                       | 1.0846  | 1.0821  | 1.0796  | 1.0680  | 1.0658  | 1.0557  | 1.0557  | 1.0538  | 1.0596  | 1.0658  | 1.0702  | 1.0748  | (40) |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0680  |      |
| Days in mont              | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31      |      |

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

|                                                                 |          |          |          |          |          |          |          |          |          |                                        |          |                |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------|----------|----------------|-------------|
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |                                        |          |                | 2.4514 (42) |
| Hot water usage for mixer showers                               | 65.3213  | 64.3396  | 62.9091  | 60.1722  | 58.1524  | 55.9000  | 54.6197  | 56.0393  | 57.5955  | 60.0140                                | 62.8097  | 65.0710 (42a)  |             |
| Hot water usage for baths                                       | 28.2135  | 27.7945  | 27.2044  | 26.1165  | 25.3018  | 24.3985  | 23.9106  | 24.4965  | 25.1345  | 26.1011                                | 27.2114  | 28.1181 (42b)  |             |
| Hot water usage for other uses                                  | 39.7346  | 38.2897  | 36.8448  | 35.3999  | 33.9550  | 32.5101  | 32.5101  | 33.9550  | 35.3999  | 36.8448                                | 38.2897  | 39.7346 (42c)  |             |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |                                        |          | 122.5047 (43)  |             |
| Daily hot water use                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                                    | Nov      | Dec            |             |
| Energy content (annual)                                         | 133.2693 | 130.4238 | 126.9584 | 121.6886 | 117.4093 | 112.8086 | 111.0404 | 114.4909 | 118.1299 | 122.9598                               | 128.3108 | 132.9237 (44)  |             |
| Distribution loss (46)m = 0.15 x (45)m                          | 211.0660 | 185.7217 | 195.1303 | 166.5856 | 158.0554 | 138.7114 | 134.2937 | 141.7636 | 145.6660 | 166.8553                               | 182.8022 | 208.1263 (45)  |             |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          | Total = Sum(45)m =                     |          | 2034.7776      |             |
| Total storage loss                                              | 31.6599  | 27.8583  | 29.2695  | 24.9878  | 23.7083  | 20.8067  | 20.1441  | 21.2645  | 21.8499  | 25.0283                                | 27.4203  | 31.2190 (46)   |             |
| 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 (56)    |             |
| Primary loss                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (57)    |             |
| Combi loss                                                      | 50.9589  | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589  | 49.3151  | 50.9589                                | 49.3151  | 50.9589 (59)   |             |
| Total heat required for water heating calculated for each month | 262.0249 | 231.7491 | 246.0892 | 215.9007 | 209.0143 | 188.0264 | 185.2527 | 192.7225 | 194.9810 | 217.8142                               | 232.1173 | 259.0852 (61)  |             |
| WWHRS                                                           | -29.8622 | -26.4103 | -27.6554 | -22.8997 | -21.3417 | -18.2623 | -17.1180 | -18.2032 | -18.8949 | -22.2750                               | -25.2348 | -29.3091 (62)  |             |
| 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 (63a)  |             |
| 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 (63b)   |             |
| 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 (63c)   |             |
| Output from w/h                                                 | 232.1628 | 205.3388 | 218.4338 | 193.0009 | 187.6726 | 169.7641 | 168.1347 | 174.5193 | 176.0862 | 195.5393                               | 206.8825 | 229.7761 (63d) |             |
| 12Total per year (kWh/year)                                     |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m = |          | 2357.3110 (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                        |          |          |          |          |          |          |          |          |          |                                        |          | 0.0000 (64a)   |             |
|                                                                 | 82.9192  | 73.2593  | 77.6205  | 67.7185  | 65.2932  | 58.4503  | 57.3924  | 59.8761  | 60.7627  | 68.2191                                | 73.1105  | 81.9417 (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                                                                               | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 124.4886 | 137.8267 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 218.1820 | 220.4460 | 214.7407 | 202.5947 | 187.2627 | 172.8527 | 163.2259 | 160.9618 | 166.6672 | 178.8131 | 194.1452 | 208.5552 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | (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   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | (71) |
| Water heating gains (Table 5)                                                       | 111.4505 | 109.0168 | 104.3287 | 94.0534  | 87.7596  | 81.1810  | 77.1403  | 80.4787  | 84.3926  | 91.6924  | 101.5424 | 110.1367 | (72) |
| Total internal gains                                                                | 516.8918 | 530.0602 | 506.3287 | 488.0571 | 462.2816 | 442.4425 | 424.6255 | 425.6998 | 439.4687 | 457.7648 | 487.0965 | 505.9513 | (73) |

## 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          |          | Access<br>factor<br>Table 6d | Gains<br>W   |  |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|----------|------------------------------|--------------|--|
| North       |          |          |          |          | 3.5800     | 10.6334                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       | 11.6339 (74) |  |
| South       |          |          |          |          | 4.6200     | 46.7521                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       | 66.0107 (78) |  |
| West        |          |          |          |          | 0.5400     | 19.6403                        | 0.6300                            | 0.7000                             |          |          |          | 0.7700                       | 3.2413 (80)  |  |
|             |          |          |          |          |            |                                |                                   |                                    |          |          |          |                              |              |  |
| Solar gains | 80.8859  | 136.6822 | 185.9326 | 231.5560 | 262.6000   | 262.7033                       | 252.3982                          | 228.5495                           | 201.4231 | 150.5944 | 96.6387  | 69.4034 (83)                 |              |  |
| Total gains | 597.7777 | 666.7424 | 692.2613 | 719.6131 | 724.8816   | 705.1458                       | 677.0237                          | 654.2493                           | 640.8919 | 608.3592 | 583.7352 | 575.3547 (84)                |              |  |

## 7. Mean internal temperature (heating season)

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

21.0000 (85)

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

|                        | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |      |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| tau                    | 30.7290 | 30.8008 | 30.8715 | 31.2081 | 31.2719 | 31.5723 | 31.5723 | 31.6285 | 31.4559 | 31.2719 | 31.1431 | 31.0096 |      |
| alpha                  | 3.0486  | 3.0534  | 3.0581  | 3.0805  | 3.0848  | 3.1048  | 3.1048  | 3.1086  | 3.0971  | 3.0848  | 3.0762  | 3.0673  |      |
| util living area       | 0.9586  | 0.9412  | 0.9184  | 0.8691  | 0.7853  | 0.6453  | 0.5037  | 0.5358  | 0.7173  | 0.8731  | 0.9387  | 0.9627  | (86) |
| MIT                    | 18.9755 | 19.2301 | 19.5770 | 20.0575 | 20.4874 | 20.8077 | 20.9344 | 20.9189 | 20.7151 | 20.1786 | 19.5115 | 18.9348 | (87) |
| Th 2                   | 20.0134 | 20.0155 | 20.0175 | 20.0271 | 20.0288 | 20.0372 | 20.0372 | 20.0387 | 20.0340 | 20.0288 | 20.0252 | 20.0214 | (88) |
| util rest of house     | 0.9520  | 0.9319  | 0.9049  | 0.8460  | 0.7445  | 0.5756  | 0.4078  | 0.4412  | 0.6550  | 0.8464  | 0.9275  | 0.9567  | (89) |
| MIT 2                  | 17.6589 | 17.9799 | 18.4167 | 19.0166 | 19.5300 | 19.8860 | 20.0008 | 19.9909 | 19.7935 | 19.1740 | 18.3453 | 17.6126 | (90) |
| Living area fraction   | 17.9060 | 18.2145 | 18.6344 | 19.2120 | 19.7096 | 20.0590 | 20.1760 | 20.1650 | 19.9664 | 19.3625 | 18.5642 | 17.8607 | (91) |
| MIT                    | 17.9060 | 18.2145 | 18.6344 | 19.2120 | 19.7096 | 20.0590 | 20.1760 | 20.1650 | 19.9664 | 19.3625 | 18.5642 | 17.8607 | (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |      |
| adjusted MIT           | 17.9060 | 18.2145 | 18.6344 | 19.2120 | 19.7096 | 20.0590 | 20.1760 | 20.1650 | 19.9664 | 19.3625 | 18.5642 | 17.8607 | (93) |

## 8. Space heating requirement

|                                                                                | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation                                                                    | 0.9326    | 0.9096    | 0.8809    | 0.8229   | 0.7293   | 0.5773   | 0.4224   | 0.4544   | 0.6501   | 0.8241   | 0.9053   | 0.9385    | (94)  |
| Useful gains                                                                   | 557.5110  | 606.4847  | 609.8095  | 592.1656 | 528.6438 | 407.0645 | 285.9445 | 297.3024 | 416.6579 | 501.3718 | 528.4756 | 539.9508  | (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                                                               | 1171.7564 | 1143.9850 | 1040.2008 | 874.4407 | 677.8216 | 457.5750 | 299.7400 | 315.0262 | 493.5468 | 741.5316 | 974.1750 | 1165.8281 | (97)  |
| Space heating kWh                                                              | 456.9986  | 361.2002  | 320.2111  | 203.2381 | 110.9883 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 178.6789 | 320.9036 | 465.6527  | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |          |          |          |          |          |          |          |          | 2417.8715 |       |
| 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                                                              | 456.9986  | 361.2002  | 320.2111  | 203.2381 | 110.9883 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 178.6789 | 320.9036 | 465.6527  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |          |          |          |          |          |          |          |          | 2417.8715 |       |
| Space heating per m <sup>2</sup>                                               |           |           |           |          |          |          |          |          |          |          |          | 30.4518   | (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 %)

92.4000 (206)

Efficiency of main space heating system 2 (in %)

0.0000 (207)

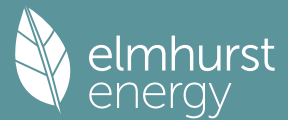
Efficiency of secondary/supplementary heating system, %

0.0000 (208)

|                                                  | Jan      | Feb      | Mar      | Apr      | May      | Jun    | Jul    | Aug    | Sep    | Oct      | Nov      | Dec      |       |
|--------------------------------------------------|----------|----------|----------|----------|----------|--------|--------|--------|--------|----------|----------|----------|-------|
| Space heating requirement                        | 456.9986 | 361.2002 | 320.2111 | 203.2381 | 110.9883 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 178.6789 | 320.9036 | 465.6527 | (98)  |
| Space heating efficiency (main heating system 1) | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.4000  | 92.4000  | 92.4000  | (210) |
| Space heating fuel (main heating system)         | 494.5872 | 390.9093 | 346.5489 | 219.9546 | 120.1172 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 193.3754 | 347.2983 | 503.9531 | (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

# Full SAP Calculation Printout



|                                                                                                              |          |          |          |           |           |           |           |           |           |          |          |                  |
|--------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------------|
| Efficiency of water heater (217)m                                                                            | 232.1628 | 205.3388 | 218.4338 | 193.0009  | 187.6726  | 169.7641  | 168.1347  | 174.5193  | 176.0862  | 195.5393 | 206.8825 | 229.7761 (64)    |
| Fuel for water heating, kWh/month                                                                            | 85.8043  | 85.5781  | 85.1997  | 84.4924   | 83.2944   | 80.3000   | 80.3000   | 80.3000   | 80.3000   | 84.1886  | 85.3183  | 85.8617 (216)    |
| Space cooling fuel requirement (221)m                                                                        | 270.5725 | 239.9431 | 256.3786 | 228.4240  | 225.3124  | 211.4124  | 209.3832  | 217.3341  | 219.2854  | 232.2632 | 242.4831 | 267.6119 (219)   |
| 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 (221)     |
| 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 (231)     |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)m                                        | 25.8663  | 20.7509  | 18.6839  | 13.6886   | 10.5735   | 8.6386    | 9.6455    | 12.5376   | 16.2850   | 21.3669  | 24.1338  | 26.5852 (232)    |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m                              | -37.0848 | -52.2376 | -75.0075 | -84.2301  | -90.7254  | -84.6417  | -83.6122  | -79.0098  | -70.8323  | -59.7180 | -40.7629 | -32.0686 (233a)  |
| 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 (234a)    |
| 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 (235a)    |
| Electricity generated by PVs (Appendix M) (negative quantity) (233b)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 wind turbines (Appendix M) (negative quantity) (234b)m                              | -21.0438 | -44.2748 | -88.0162 | -132.2155 | -174.8415 | -175.6844 | -173.5997 | -146.9539 | -107.6821 | -63.2994 | -28.0911 | -16.6385 (233b)  |
| 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 (234b)    |
| 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 (235b)    |
| Annual totals kWh/year                                                                                       | 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)    |
| Space heating fuel - main system 1                                                                           |          |          |          |           |           |           |           |           |           |          |          | 2616.7440 (211)  |
| Space heating fuel - main system 2                                                                           |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (213)     |
| Space heating fuel - secondary                                                                               |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (215)     |
| Efficiency of water heater                                                                                   |          |          |          |           |           |           |           |           |           |          |          | 80.3000          |
| Water heating fuel used                                                                                      |          |          |          |           |           |           |           |           |           |          |          | 2820.4040 (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)                                                          |          |          |          |           |           |           |           |           |           |          |          | 208.7557 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                                                |          |          |          |           |           |           |           |           |           |          |          |                  |
| PV generation                                                                                                |          |          |          |           |           |           |           |           |           |          |          | -1962.2720 (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                                                                          |          |          |          |           |           |           |           |           |           |          |          | 3769.6317 (238)  |

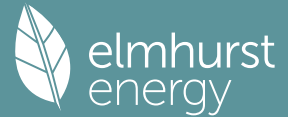
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year |
|-----------------------------------------------|-----------------|----------------------------|-----------------------|
| Space heating - main system 1                 | 2616.7440       | 0.2100                     | 549.5162 (261)        |
| Total CO2 associated with community systems   |                 |                            | 0.0000 (373)          |
| Water heating (other fuel)                    | 2820.4040       | 0.2100                     | 592.2848 (264)        |
| Space and water heating                       |                 |                            | 1141.8011 (265)       |
| Pumps, fans and electric keep-hot             | 86.0000         | 0.1387                     | 11.9293 (267)         |
| Energy for lighting                           | 208.7557        | 0.1443                     | 30.1299 (268)         |
| Energy saving/generation technologies         |                 |                            |                       |
| PV Unit electricity used in dwelling          | -789.9309       | 0.1346                     | -106.3323             |
| PV Unit electricity exported                  | -1172.3411      | 0.1259                     | -147.5892             |
| Total                                         |                 |                            | -253.9214 (269)       |
| Total CO2, kg/year                            |                 |                            | 929.9388 (272)        |
| EPC Target Carbon Dioxide Emission Rate (TER) |                 |                            | 11.7100 (273)         |

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

|                                             | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year |
|---------------------------------------------|-----------------|----------------------------------|-------------------------|
| Space heating - main system 1               | 2616.7440       | 1.1300                           | 2956.9207 (275)         |
| Total CO2 associated with community systems |                 |                                  | 0.0000 (473)            |
| Water heating (other fuel)                  | 2820.4040       | 1.1300                           | 3187.0565 (278)         |
| Space and water heating                     |                 |                                  | 6143.9773 (279)         |
| Pumps, fans and electric keep-hot           | 86.0000         | 1.5128                           | 130.1008 (281)          |
| Energy for lighting                         | 208.7557        | 1.5338                           | 320.1964 (282)          |
| Energy saving/generation technologies       |                 |                                  |                         |
| PV Unit electricity used in dwelling        | -789.9309       | 1.4975                           | -1182.9180              |
| PV Unit electricity exported                | -1172.3411      | 0.4621                           | -541.7535               |
| Total                                       |                 |                                  | -1724.6716 (283)        |
| Total Primary energy kWh/year               |                 |                                  | 4869.6030 (286)         |
| Target Primary Energy Rate (TPER)           |                 |                                  | 61.3300 (287)           |

# Full SAP Calculation Printout



|                                    |                        |               |       |      |                |            |
|------------------------------------|------------------------|---------------|-------|------|----------------|------------|
| Property Reference                 | 2708 2B4P              |               |       |      | Issued on Date | 22/11/2024 |
| Assessment Reference               | LZC                    | Prop Type Ref |       |      |                |            |
| Property                           | B2009 2B4P,            |               |       |      |                |            |
|                                    |                        |               |       |      |                |            |
| SAP Rating                         | 90 B                   | DER           | 1.45  | TER  | 11.46          |            |
| Environmental                      | 99 A                   | % DER < TER   |       |      |                | 87.35      |
| CO <sub>2</sub> Emissions (t/year) | 0.09                   | DFEE          | 27.88 | TFEE | 35.54          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |      |                | 21.55      |
| % DPER < TPER                      | 71.55                  | DPER          | 17.06 | TPER | 59.98          |            |
|                                    |                        |               |       |      |                |            |
| Assessor Details                   | Mr. Michael Woodbridge |               |       |      | Assessor ID    | M818-0001  |
| Client                             |                        |               |       |      |                |            |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 39.7000 (1b)              | x 2.5000 (2b)                   | = 99.2500 (1b) - (3b)       |
| First floor                                            | 39.7000 (1c)              | x 2.6000 (2c)                   | = 103.2200 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 202.4700 (5)              |

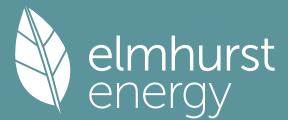
## 2. Ventilation rate

|                                                                                                         | 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                                                                                    | 4.0000 (17)                                                                     |        |        |        |        |        |        |        |        |        |        |              |
| Infiltration rate                                                                                       | 0.2000 (18)                                                                     |        |        |        |        |        |        |        |        |        |        |              |
| Number of sides sheltered                                                                               | 3 (19)                                                                          |        |        |        |        |        |        |        |        |        |        |              |
| Shelter factor                                                                                          | (20) = 1 - [0.075 x (19)] = 0.7750 (20)                                         |        |        |        |        |        |        |        |        |        |        |              |
| Infiltration rate adjusted to include shelter factor                                                    | (21) = (18) x (20) = 0.1550 (21)                                                |        |        |        |        |        |        |        |        |        |        |              |
| Wind speed                                                                                              | Jan                                                                             | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
| Wind factor                                                                                             | 5.1000                                                                          | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Adj infilt rate                                                                                         | 1.2750                                                                          | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Balanced mechanical ventilation with heat recovery                                                      | 0.1976                                                                          | 0.1938 | 0.1899 | 0.1705 | 0.1666 | 0.1473 | 0.1473 | 0.1434 | 0.1550 | 0.1666 | 0.1744 | 0.1821 (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) =            | 70.3800 (23c)                                                                   |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac                                                                                            | 0.3457                                                                          | 0.3419 | 0.3380 | 0.3186 | 0.3147 | 0.2954 | 0.2954 | 0.2915 | 0.3031 | 0.3147 | 0.3225 | 0.3302 (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   |
|--------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| W1 (Uw = 0.80)                                               |                         |                            | 2.6400                    | 0.7752                        | 2.0465       |                                | (27)            |
| W2 (Uw = 0.80)                                               |                         |                            | 1.4400                    | 0.7752                        | 1.1163       |                                | (27)            |
| W3 (Uw = 0.80)                                               |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| W4 (Uw = 0.80)                                               |                         |                            | 2.3800                    | 0.7752                        | 1.8450       |                                | (27)            |
| W5 (Uw = 0.80)                                               |                         |                            | 1.2000                    | 0.7752                        | 0.9302       |                                | (27)            |
| W6 (Uw = 0.80)                                               |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| Front Door                                                   |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26)            |
| Rear door                                                    |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26a)           |
| Ground floor                                                 |                         |                            | 39.7000                   | 0.1200                        | 4.7640       | 110.0000                       | 4367.0000 (28a) |
| External Walls                                               | 93.1260                 | 13.2400                    | 79.8860                   | 0.1500                        | 11.9829      | 9.0000                         | 718.9740 (29a)  |
| Roof at ceiling                                              | 39.7000                 |                            | 39.7000                   | 0.1100                        | 4.3670       | 9.0000                         | 357.3000 (30)   |
| Total net area of external elements Aum (A, m <sup>2</sup> ) |                         |                            | 172.5260                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                          |                         |                            | (26)...(30) + (32) =      |                               | 32.3891      |                                | (33)            |
| Party Walls                                                  |                         |                            | 38.6070                   | 0.0000                        | 0.0000       | 45.0000                        | 1737.3149 (32)  |

# Full SAP Calculation Printout



|                  |          |         |                 |
|------------------|----------|---------|-----------------|
| Internal Walls   | 141.6180 | 9.0000  | 1274.5620 (32c) |
| Internal floor   | 39.7000  | 18.0000 | 714.6000 (32d)  |
| Internal ceiling | 39.7000  | 9.0000  | 357.3000 (32e)  |

Heat capacity  $C_m = \text{Sum}(A \times k)$  (28)...(30) + (32) + (32a)...(32e) = 9527.0509 (34)  
 Thermal mass parameter (TMP =  $C_m / \text{TFA}$ ) in kJ/m<sup>2</sup>K 119.9880 (35)

## List of Thermal Bridges

| K1 Element                                                                | Length  | Psi-value | Total   |
|---------------------------------------------------------------------------|---------|-----------|---------|
| E2 Other lintels (including other steel lintels)                          | 9.8600  | 0.0540    | 0.5324  |
| E3 Sill                                                                   | 7.7200  | 0.0400    | 0.3088  |
| E4 Jamb                                                                   | 23.9000 | 0.0240    | 0.5736  |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0630    | 0.0000  |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.1000    | 0.0000  |
| E14 Flat roof                                                             | 0.0000  | 0.0600    | 0.0000  |
| E16 Corner (normal)                                                       | 10.2000 | 0.0400    | 0.4080  |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000  | -0.0630   | -0.0000 |
| E18 Party wall between dwellings                                          | 10.2000 | 0.0490    | 0.4998  |
| E25 Staggered party wall between dwellings                                | 0.0000  | 0.0570    | 0.0000  |
| E5 Ground floor (normal)                                                  | 18.2400 | 0.0550    | 1.0032  |
| E6 Intermediate floor within a dwelling                                   | 18.2400 | 0.0250    | 0.4560  |
| E10 Eaves (insulation at ceiling level)                                   | 18.2400 | 0.0420    | 0.7661  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 7.5500  | 0.0340    | 0.2567  |
| P1 Party wall - Ground floor                                              | 7.5500  | 0.3200    | 2.4160  |
| P2 Party wall - Intermediate floor within a dwelling                      | 7.5500  | 0.0000    | 0.0000  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.2206 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 39.6097 (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          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| 23.0997                   | 22.8407 | 22.5818 | 21.2873 | 21.0284 | 19.7338 | 19.7338 | 19.4749 | 20.2517 | 21.0284 | 21.5462 | 22.0640 | (38)         |
| Heat transfer coeff       | 62.7094 | 62.4505 | 62.1915 | 60.8970 | 60.6381 | 59.3436 | 59.3436 | 59.0846 | 59.8614 | 60.6381 | 61.1559 | 61.6737 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 60.8323      |
| HLP                       | 0.7898  | 0.7865  | 0.7833  | 0.7670  | 0.7637  | 0.7474  | 0.7474  | 0.7441  | 0.7539  | 0.7637  | 0.7702  | 0.7767 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.7661       |
| Days in mont              | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31           |

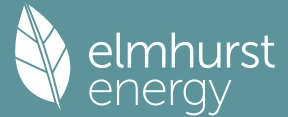
## 4. Water heating energy requirements (kWh/year)

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          | 2.4514 (42)    |
| Hot water usage for mixer showers                                              | 65.3213  | 64.3396  | 62.9091  | 60.1722  | 58.1524  | 55.9000  | 54.6197  | 56.0393  | 57.5955  | 60.0140  | 62.8097  | 65.0710 (42a)  |
| Hot water usage for baths                                                      | 28.2135  | 27.7945  | 27.2044  | 26.1165  | 25.3018  | 24.3985  | 23.9106  | 24.4965  | 25.1345  | 26.1011  | 27.2114  | 28.1181 (42b)  |
| Hot water usage for other uses                                                 | 39.7346  | 38.2897  | 36.8448  | 35.3999  | 33.9550  | 32.5101  | 32.5101  | 33.9550  | 35.3999  | 36.8448  | 38.2897  | 39.7346 (42c)  |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          | 122.5047 (43)  |
| Daily hot water use                                                            | 133.2693 | 130.4238 | 126.9584 | 121.6886 | 117.4093 | 112.8086 | 111.0404 | 114.4909 | 118.1299 | 122.9598 | 128.3108 | 132.9237 (44)  |
| Energy content (annual)                                                        | 211.0660 | 185.7217 | 195.1303 | 166.5856 | 158.0554 | 138.7114 | 134.2937 | 141.7636 | 145.6660 | 166.8553 | 182.8022 | 208.1263 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                                         | 31.6599  | 27.8583  | 29.2695  | 24.9878  | 23.7083  | 20.8067  | 20.1441  | 21.2645  | 21.8499  | 25.0283  | 27.4203  | 31.2190 (46)   |
| Water storage loss:                                                            |          |          |          |          |          |          |          |          |          |          |          | 200.0000 (47)  |
| Store volume                                                                   |          |          |          |          |          |          |          |          |          |          |          | 1.3200 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day):                    |          |          |          |          |          |          |          |          |          |          |          | 0.6000 (49)    |
| Temperature factor from Table 2b                                               |          |          |          |          |          |          |          |          |          |          |          | 0.7920 (55)    |
| Enter (49) or (54) in (55)                                                     |          |          |          |          |          |          |          |          |          |          |          |                |
| Total storage loss                                                             | 24.5520  | 22.1760  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520 (56)   |
| If cylinder contains dedicated solar storage                                   | 24.5520  | 22.1760  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520 (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                | 258.8804 | 228.9089 | 242.9447 | 212.8576 | 205.8698 | 184.9834 | 182.1081 | 189.5780 | 191.9380 | 214.6697 | 229.0742 | 255.9407 (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                                                                | 258.8804 | 228.9089 | 242.9447 | 212.8576 | 205.8698 | 184.9834 | 182.1081 | 189.5780 | 191.9380 | 214.6697 | 229.0742 | 255.9407 (64)  |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          |          |          | 2597.7536 (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                                       | 108.4310 | 96.3022  | 103.1323 | 92.4073  | 90.8050  | 83.1391  | 82.9042  | 85.3879  | 85.4515  | 93.7309  | 97.7993  | 107.4535 (65)  |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 124.4886 | 137.8267 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 218.1820 | 220.4460 | 214.7407 | 202.5947 | 187.2627 | 172.8527 | 163.2259 | 160.9618 | 166.6672 | 178.8131 | 194.1452 | 208.5552 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 (71) |
| Water heating gains (Table 5)                                                       | 145.7406 | 143.3069 | 138.6187 | 128.3435 | 122.0497 | 115.4710 | 111.4304 | 114.7687 | 118.6827 | 125.9824 | 135.8324 | 144.4268 (72) |
| Total internal gains                                                                | 548.1818 | 561.3503 | 537.6187 | 519.3472 | 493.5716 | 476.7326 | 458.9156 | 459.9898 | 473.7588 | 489.0548 | 518.3865 | 537.2413 (73) |

# Full SAP Calculation Printout



## 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    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| South       |          |          |          |          | 2.6400     | 46.7521                        | 0.6300                            | 0.0000                             |          |          | 0.7700                       | 59.8737 (78)  |
| South       |          |          |          |          | 1.4400     | 46.7521                        | 0.6300                            | 0.0000                             |          |          | 0.7700                       | 32.6584 (78)  |
| South       |          |          |          |          | 0.5400     | 46.7521                        | 0.6300                            | 0.0000                             |          |          | 0.7700                       | 12.2469 (78)  |
| North       |          |          |          |          | 2.3800     | 10.6334                        | 0.6300                            | 0.0000                             |          |          | 0.7700                       | 12.2767 (74)  |
| North       |          |          |          |          | 1.2000     | 10.6334                        | 0.6300                            | 0.0000                             |          |          | 0.7700                       | 6.1899 (74)   |
| West        |          |          |          |          | 0.5400     | 19.6403                        | 0.6300                            | 0.0000                             |          |          | 0.7700                       | 5.1448 (80)   |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 128.3904 | 216.9559 | 295.1311 | 367.5491 | 416.8254   | 416.9893                       | 400.6320                          | 362.7770                           | 319.7193 | 239.0388 | 153.3947                     | 110.1642 (83) |
| Total gains | 676.5722 | 778.3062 | 832.7498 | 886.8963 | 910.3971   | 893.7219                       | 859.5475                          | 822.7668                           | 793.4780 | 728.0936 | 671.7812                     | 647.4055 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 42.2011 | 42.3760 | 42.5525 | 43.4570 | 43.6426 | 44.5946 | 44.5946 | 44.7900 | 44.2089 | 43.6426 | 43.2731 | 42.9097 |              |
| alpha                                                                       | 3.8134  | 3.8251  | 3.8368  | 3.8971  | 3.9095  | 3.9730  | 3.9730  | 3.9860  | 3.9473  | 3.9095  | 3.8849  | 3.8606  |              |
| util living area                                                            | 0.9238  | 0.8804  | 0.8236  | 0.7164  | 0.5794  | 0.4167  | 0.3019  | 0.3276  | 0.5008  | 0.7355  | 0.8770  | 0.9320  | (86)         |
| MIT                                                                         | 19.9106 | 20.1729 | 20.4416 | 20.7361 | 20.9050 | 20.9806 | 20.9958 | 20.9942 | 20.9591 | 20.7524 | 20.3222 | 19.8785 | (87)         |
| Th 2                                                                        | 20.2622 | 20.2650 | 20.2679 | 20.2821 | 20.2849 | 20.2992 | 20.2992 | 20.3020 | 20.2934 | 20.2849 | 20.2792 | 20.2735 | (88)         |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9142  | 0.8666  | 0.8041  | 0.6883  | 0.5424  | 0.3734  | 0.2546  | 0.2789  | 0.4546  | 0.7033  | 0.8607  | 0.9234  | (89)         |
| MIT 2                                                                       | 18.9960 | 19.3202 | 19.6487 | 20.0062 | 20.1954 | 20.2842 | 20.2967 | 20.2985 | 20.2598 | 20.0337 | 19.5200 | 18.9648 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 19.1676 | 19.4802 | 19.7975 | 20.1432 | 20.3286 | 20.4149 | 20.4279 | 20.4291 | 20.3910 | 20.1685 | 19.6705 | 19.1362 | (91)         |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |         |         |         |              |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.1676 | 19.4802 | 19.7975 | 20.1432 | 20.3286 | 20.4149 | 20.4279 | 20.4291 | 20.3910 | 20.1685 | 19.6705 | 19.1362 | (93)         |

## 8. Space heating requirement

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |           |       |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Utilisation                                                                    | 0.8973   | 0.8499   | 0.7905   | 0.6826   | 0.5447   | 0.3807   | 0.2633   | 0.2879   | 0.4611   | 0.6977   | 0.8452   | 0.9071    | (94)  |
| Useful gains                                                                   | 607.0842 | 661.5094 | 658.2817 | 605.4110 | 495.8948 | 340.2007 | 226.3156 | 236.8462 | 365.8801 | 508.0236 | 567.7594 | 587.2683  | (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                                                               | 932.3397 | 910.5406 | 826.9908 | 684.6744 | 523.2199 | 345.0743 | 227.1618 | 238.0551 | 376.5897 | 580.2179 | 768.7611 | 921.1722  | (97)  |
| Space heating kWh                                                              | 241.9901 | 167.3490 | 125.5196 | 57.0697  | 20.3299  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 53.7125  | 144.7212 | 248.4245  | (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |          |          | 1059.1164 |       |
| 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                                                              | 241.9901 | 167.3490 | 125.5196 | 57.0697  | 20.3299  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 53.7125  | 144.7212 | 248.4245  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |          |          | 1059.1164 |       |
| Space heating per m2                                                           |          |          |          |          |          |          |          |          |          |          |          | 13.3390   | (99)  |

## 9b. Energy requirements

|                                                                                         |          |          |          |          |          |          |          |          |          |          |          |              |               |
|-----------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|---------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   |          |          |          |          |          |          |          |          |          |          |          |              | 0.0000 (301)  |
| Fraction of space heat from community system                                            |          |          |          |          |          |          |          |          |          |          |          |              | 1.0000 (302)  |
| Fraction of heat from community Heat pump-Space and Water                               |          |          |          |          |          |          |          |          |          |          |          |              | 1.0000 (303a) |
| Factor for control and charging method (Table 4c(3)) for space heating                  |          |          |          |          |          |          |          |          |          |          |          |              | 1.0000 (305)  |
| Factor for charging method (Table 4c(3)) for water heating                              |          |          |          |          |          |          |          |          |          |          |          |              | 1.0000 (305a) |
| Distribution loss factor (Table 12c) for community heating system                       |          |          |          |          |          |          |          |          |          |          |          |              | 1.1000 (306)  |
| Efficiency of secondary/supplementary heating system, %                                 |          |          |          |          |          |          |          |          |          |          |          |              | 0.0000 (208)  |
| Space heating:                                                                          |          |          |          |          |          |          |          |          |          |          |          |              |               |
| Space heating requirement                                                               | 241.9901 | 167.3490 | 125.5196 | 57.0697  | 20.3299  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 53.7125  | 144.7212 | 248.4245     | (98)          |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10                                   |          |          |          |          |          |          |          |          |          |          |          |              |               |
| 307a                                                                                    | 266.1891 | 184.0839 | 138.0715 | 62.7766  | 22.3629  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 59.0838  | 159.1933 | 273.2669     |               |
| Space heating requirement                                                               | 266.1891 | 184.0839 | 138.0715 | 62.7766  | 22.3629  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 59.0838  | 159.1933 | 273.2669     | (307)         |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (308) |               |
| Space heating fuel for secondary/supplementary system                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000       | (309)         |
| Water heating                                                                           |          |          |          |          |          |          |          |          |          |          |          |              |               |
| Annual water heating requirement                                                        | 258.8804 | 228.9089 | 242.9447 | 212.8576 | 205.8698 | 184.9834 | 182.1081 | 189.5780 | 191.9380 | 214.6697 | 229.0742 | 255.9407     | (64)          |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10                                   |          |          |          |          |          |          |          |          |          |          |          |              |               |
| 310a                                                                                    | 284.7685 | 251.7998 | 267.2391 | 234.1434 | 226.4568 | 203.4817 | 200.3190 | 208.5358 | 211.1318 | 236.1367 | 251.9816 | 281.5348     |               |
| Water heating fuel                                                                      | 284.7685 | 251.7998 | 267.2391 | 234.1434 | 226.4568 | 203.4817 | 200.3190 | 208.5358 | 211.1318 | 236.1367 | 251.9816 | 281.5348     | (310)         |
| Cooling System Energy Efficiency Ratio                                                  |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (314) |               |
| Space coolin                                                                            | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000       | (315)         |
| Pumps and Fa                                                                            | 13.1120  | 11.8431  | 13.1120  | 12.6890  | 13.1120  | 12.6890  | 13.1120  | 13.1120  | 12.6890  | 13.1120  | 12.6890  | 13.1120      | (331)         |
| Lighting                                                                                | 30.0194  | 24.0827  | 21.6838  | 15.8865  | 12.2712  | 10.0256  | 11.1942  | 14.5506  | 18.8998  | 24.7975  | 28.0088  | 30.8537      | (332)         |
| Electricity generated by PVs (Appendix M) (negative quantity)                           |          |          |          |          |          |          |          |          |          |          |          |              |               |
| (333a)m                                                                                 | -22.8036 | -35.9441 | -57.3301 | -71.1849 | -82.4218 | -78.9820 | -78.0041 | -70.8477 | -59.0707 | -44.0714 | -26.3980 | -19.2728     | (333a)        |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                 |          |          |          |          |          |          |          |          |          |          |          |              |               |
| (334a)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       | (334a)        |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)     |          |          |          |          |          |          |          |          |          |          |          |              |               |
| (335a)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       | (335a)        |
| Electricity generated by PVs (Appendix M) (negative quantity)                           |          |          |          |          |          |          |          |          |          |          |          |              |               |
| (333b)m                                                                                 | -2.2396  | -5.8459  | -13.8430 | -24.2012 | -35.4196 | -36.8749 | -36.3216 | -29.0393 | -19.1608 | -9.3515  | -3.3069  | -1.6841      | (333b)        |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                 |          |          |          |          |          |          |          |          |          |          |          |              |               |
| (334b)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       | (334b)        |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)     |          |          |          |          |          |          |          |          |          |          |          |              |               |

# Full SAP Calculation Printout



|                                                                            |        |        |        |        |        |        |        |        |        |        |        |           |        |
|----------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| (335b)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    | (335b) |
| Annual totals kWh/year                                                     |        |        |        |        |        |        |        |        |        |        |        |           |        |
| Space heating fuel - community heating                                     |        |        |        |        |        |        |        |        |        |        |        | 1165.0281 | (307)  |
| Space heating fuel - secondary                                             |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (309)  |
| Water heating fuel - community heating                                     |        |        |        |        |        |        |        |        |        |        |        | 2857.5289 | (310)  |
| Efficiency of water heater                                                 |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (311)  |
| Electricity used for heat distribution                                     |        |        |        |        |        |        |        |        |        |        |        | 11.6503   | (313)  |
| Space cooling fuel                                                         |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (321)  |
| Electricity for pumps and fans:                                            |        |        |        |        |        |        |        |        |        |        |        |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250) |        |        |        |        |        |        |        |        |        |        |        |           |        |
| mechanical ventilation fans (SFP = 0.6250)                                 |        |        |        |        |        |        |        |        |        |        |        | 154.3834  | (330a) |
| Total electricity for the above, kWh/year                                  |        |        |        |        |        |        |        |        |        |        |        | 154.3834  | (331)  |
| Electricity for lighting (calculated in Appendix L)                        |        |        |        |        |        |        |        |        |        |        |        | 242.2737  | (332)  |
| Energy saving/generation technologies (Appendices M ,N and Q)              |        |        |        |        |        |        |        |        |        |        |        |           |        |
| PV generation                                                              |        |        |        |        |        |        |        |        |        |        |        | -863.6197 | (333)  |
| Wind generation                                                            |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (334)  |
| Hydro-electric generation (Appendix N)                                     |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (335a) |
| Electricity generated - Micro CHP (Appendix N)                             |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (335)  |
| Appendix Q - special features                                              |        |        |        |        |        |        |        |        |        |        |        |           |        |
| Energy saved or generated                                                  |        |        |        |        |        |        |        |        |        |        |        | -0.0000   | (336)  |
| Energy used                                                                |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (337)  |
| Total delivered energy for all uses                                        |        |        |        |        |        |        |        |        |        |        |        | 3555.5944 | (338)  |

## 12b. Carbon dioxide emissions - Community heating scheme

|                                                         | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |       |
|---------------------------------------------------------|--------------------|-------------------------------|--------------------------|-------|
| Efficiency of heat source Heat pump                     |                    |                               | 354.0000                 | (367) |
| Space and Water heating from Heat pump                  | 1136.3155          | 0.1567                        | 51.5571                  | (367) |
| Electrical energy for heat distribution (space & water) | 11.6503            | 0.0000                        | 5.8530                   | (372) |
| Overall CO2 factor for heat network                     |                    |                               | 0.0426                   | (386) |
| Total CO2 associated with community systems             |                    |                               | 171.1923                 | (373) |
| Space and water heating                                 |                    |                               | 171.1923                 | (376) |
| Pumps, fans and electric keep-hot                       | 154.3834           | 0.1387                        | 21.4149                  | (378) |
| Energy for lighting                                     | 242.2737           | 0.1443                        | 34.9676                  | (379) |
| Energy saving/generation technologies                   |                    |                               |                          |       |
| PV Unit electricity used in dwelling                    | -646.3312          | 0.1326                        | -85.6978                 |       |
| PV Unit electricity exported                            | -217.2885          | 0.1219                        | -26.4840                 |       |
| Total                                                   |                    |                               | -112.1817                | (380) |
| Total CO2, kg/year                                      |                    |                               | 115.3930                 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER)         |                    |                               | 1.4500                   | (384) |

## 13b. Primary energy - Community heating scheme

|                                                         | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |        |
|---------------------------------------------------------|--------------------|-------------------------------------|----------------------------|--------|
| Efficiency of heat source Heat pump                     |                    |                                     | 354.0000                   | (467a) |
| Space and Water heating from Heat pump                  | 1136.3155          | 1.5799                              | 519.9672                   | (467)  |
| Electrical energy for heat distribution (space & water) | 11.6503            | 0.0000                              | 61.8759                    | (472)  |
| Overall CO2 factor for heat network                     |                    |                                     | 0.4499                     | (486)  |
| Total CO2 associated with community systems             |                    |                                     | 1809.7822                  | (473)  |
| Space and water heating                                 |                    |                                     | 1809.7822                  | (476)  |
| Pumps, fans and electric keep-hot                       | 154.3834           | 1.5128                              | 233.5512                   | (478)  |
| Energy for lighting                                     | 242.2737           | 1.5338                              | 371.6075                   | (479)  |
| Energy saving/generation technologies                   |                    |                                     |                            |        |
| PV Unit electricity used in dwelling                    | -646.3312          | 1.4899                              | -962.9831                  |        |
| PV Unit electricity exported                            | -217.2885          | 0.4472                              | -97.1719                   |        |
| Total                                                   |                    |                                     | -1060.1550                 | (480)  |
| Total Primary energy kWh/year                           |                    |                                     | 1354.7860                  | (483)  |
| Dwelling Primary energy Rate (DPER)                     |                    |                                     | 17.0600                    | (484)  |

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

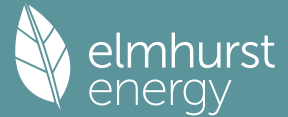
### 1. Overall dwelling characteristics

|                                                        | Area<br>(m2) | Storey height<br>(m)                        | Volume<br>(m3)         |  |
|--------------------------------------------------------|--------------|---------------------------------------------|------------------------|--|
| Ground floor                                           | 39.7000 (1b) | x 2.5000 (2b)                               | = 99.2500 (1b) - (3b)  |  |
| First floor                                            | 39.7000 (1c) | x 2.6000 (2c)                               | = 103.2200 (1c) - (3c) |  |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.4000      |                                             | (4)                    |  |
| Dwelling volume                                        |              | (3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = | 202.4700 (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)  |

# Full SAP Calculation Printout



Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 30.0000 / (5) = 0.1482 (8)  
Pressure Test  
Pressure Test Method  
Measured/design AP50  
Infiltration rate  
Number of sides sheltered

Shelter factor  
Infiltration rate adjusted to include shelter factor (20) = 1 - [0.075 x (19)] = 0.7750 (20)  
(21) = (18) x (20) = 0.3086 (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 | 0.3934 | 0.3857 | 0.3780 | 0.3394 | 0.3317 | 0.2932 | 0.2932 | 0.2854 | 0.3086 | 0.3317 | 0.3472 | 0.3626 (22b) |
| Effective ac    | 0.5774 | 0.5744 | 0.5714 | 0.5576 | 0.5550 | 0.5430 | 0.5430 | 0.5407 | 0.5476 | 0.5550 | 0.5603 | 0.5657 (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                                |             |                | 2.2500        | 1.0000           | 2.2500                       |                   | (26)          |
| TER Semi-glazed door                           |             |                | 2.2500        | 1.0000           | 2.2500                       |                   | (26a)         |
| TER Opening Type (Uw = 1.20)                   |             |                | 8.7400        | 1.1450           | 10.0076                      |                   | (27)          |
| Ground floor                                   |             |                | 39.7000       | 0.1300           | 5.1610                       |                   | (28a)         |
| External Walls                                 | 93.1260     | 13.2400        | 79.8860       | 0.1800           | 14.3795                      |                   | (29a)         |
| Roof at ceiling                                | 39.7000     |                | 39.7000       | 0.1100           | 4.3670                       |                   | (30)          |
| Total net area of external elements Aum(A, m2) |             |                | 172.5260      |                  |                              |                   | (31)          |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               |                  | (26)...(30) + (32) = 38.4151 |                   | (33)          |
| Party Walls                                    |             |                | 38.6070       | 0.0000           | 0.0000                       |                   | (32)          |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 119.9880 (35)

#### List of Thermal Bridges

|                                                                           | Length  | Psi-value | Total   |
|---------------------------------------------------------------------------|---------|-----------|---------|
| K1 Element                                                                | 9.8600  | 0.0500    | 0.4930  |
| E2 Other lintels (including other steel lintels)                          | 7.7200  | 0.0500    | 0.3860  |
| E3 Sill                                                                   | 23.9000 | 0.0500    | 1.1950  |
| E4 Jamb                                                                   | 0.0000  | 0.0700    | 0.0000  |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0000    | 0.0000  |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.0800    | 0.0000  |
| E14 Flat roof                                                             | 10.2000 | 0.0900    | 0.9180  |
| E16 Corner (normal)                                                       | 0.0000  | -0.0900   | -0.0000 |
| E17 Corner (inverted - internal area greater than external area)          | 10.2000 | 0.0600    | 0.6120  |
| E18 Party wall between dwellings                                          | 0.0000  | 0.0600    | 0.0000  |
| E25 Staggered party wall between dwellings                                | 18.2400 | 0.1600    | 2.9184  |
| E5 Ground floor (normal)                                                  | 18.2400 | 0.0000    | 0.0000  |
| E6 Intermediate floor within a dwelling                                   | 18.2400 | 0.0600    | 1.0944  |
| E10 Eaves (insulation at ceiling level)                                   | 0.0000  | 0.0000    | 0.0000  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 7.5500  | 0.1200    | 0.9060  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 7.5500  | 0.0800    | 0.6040  |
| P1 Party wall - Ground floor                                              | 7.5500  | 0.0000    | 0.0000  |
| P2 Party wall - Intermediate floor within a dwelling                      |         |           |         |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.1268 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 47.5419 (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       | 38.5789 | 38.3781 | 38.1813 | 37.2568 | 37.0838 | 36.2785 | 36.2785 | 36.1294 | 36.5887 | 37.0838 | 37.4337 | 37.7995 (38) |
| Average = Sum(39)m / 12 = | 86.1208 | 85.9200 | 85.7232 | 84.7987 | 84.6257 | 83.8205 | 83.8205 | 83.6713 | 84.1306 | 84.6257 | 84.9756 | 85.3415 (39) |

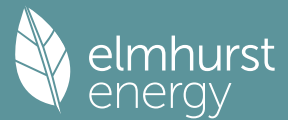
|               |        |        |        |        |        |        |        |        |        |        |        |             |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
| HLP (average) | 1.0846 | 1.0821 | 1.0796 | 1.0680 | 1.0658 | 1.0557 | 1.0557 | 1.0538 | 1.0596 | 1.0658 | 1.0702 | 1.0748 (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                        |         |         |         |         |         |         |         |         |         |         |         | 2.4514 (42)   |
| Hot water usage for mixer showers        | 65.3213 | 64.3396 | 62.9091 | 60.1722 | 58.1524 | 55.9000 | 54.6197 | 56.0393 | 57.5955 | 60.0140 | 62.8097 | 65.0710 (42a) |
| Hot water usage for baths                | 28.2135 | 27.7945 | 27.2044 | 26.1165 | 25.3018 | 24.3985 | 23.9106 | 24.4965 | 25.1345 | 26.1011 | 27.2114 | 28.1181 (42b) |
| Hot water usage for other uses           | 39.7346 | 38.2897 | 36.8448 | 35.3999 | 33.9550 | 32.5101 | 32.5101 | 33.9550 | 35.3999 | 36.8448 | 38.2897 | 39.7346 (42c) |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |         | 122.5047 (43) |

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Daily hot water use                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Energy conte                                                    | 133.2693 | 130.4238 | 126.9584 | 121.6886 | 117.4093 | 112.8086 | 111.0404 | 114.4909 | 118.1299 | 122.9598 | 128.3108 | 132.9237 (44)  |
| Energy content (annual)                                         | 211.0660 | 185.7217 | 195.1303 | 166.5856 | 158.0554 | 138.7114 | 134.2937 | 141.7636 | 145.6660 | 166.8553 | 182.8022 | 208.1263 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 31.6599  | 27.8583  | 29.2695  | 24.9878  | 23.7083  | 20.8067  | 20.1441  | 21.2645  | 21.8499  | 25.0283  | 27.4203  | 31.2190 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 200.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 1.6525 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.8924 (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 | 261.9921 | 231.7194 | 246.0563 | 215.8689 | 208.9815 | 187.9947 | 185.2198 | 192.6897 | 194.9493 | 217.7814 | 232.0855 | 259.0524 (62)  |
| WWHRS                                                           | -29.8622 | -26.4103 | -27.6554 | -22.8997 | -21.3417 | -18.2623 | -17.1180 | -18.2032 | -18.8949 | -22.2750 | -25.2348 | -29.3091 (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)   |

# Full SAP Calculation Printout



|                                          |                                                                                |          |          |          |          |          |          |          |          |          |          |                |
|------------------------------------------|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| 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                          | 232.1300                                                                       | 205.3091 | 218.4010 | 192.9691 | 187.6398 | 169.7324 | 168.1018 | 174.4864 | 176.0544 | 195.5064 | 206.8507 | 229.7433 (64)  |
|                                          |                                                                                |          |          |          |          |          |          |          |          |          |          | 2356.9244 (64) |
| 12Total per year (kWh/year)              | Total per year (kWh/year) = Sum(64)m =                                         |          |          |          |          |          |          |          |          |          |          | 2357 (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 | 110.9203                                                                       | 98.5507  | 105.6217 | 94.8163  | 93.2943  | 85.5482  | 85.3935  | 87.8773  | 87.8606  | 96.2202  | 100.2084 | 109.9429 (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                                                                               | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | 122.5689 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 124.4886 | 137.8267 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 | 124.4886 | 128.6383 | 124.4886 | 128.6383 | 124.4886 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 218.1820 | 220.4460 | 214.7407 | 202.5947 | 187.2627 | 172.8527 | 163.2259 | 160.9618 | 166.6672 | 178.8131 | 194.1452 | 208.5552 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | 35.2569  | (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   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | -98.0551 | (71) |
| Water heating gains (Table 5)                                                       | 149.0864 | 146.6528 | 141.9646 | 131.6894 | 125.3956 | 118.8169 | 114.7762 | 118.1146 | 122.0286 | 129.3283 | 139.1783 | 147.7727 | (72) |
| Total internal gains                                                                | 554.5277 | 567.6962 | 543.9646 | 525.6930 | 499.9175 | 480.0785 | 462.2614 | 463.3357 | 477.1047 | 495.4007 | 524.7324 | 543.5872 | (73) |

## 6. Solar gains

| [Jan]       |          |          |          |          |            |                                |          |                                   |                                    |                              |          |               |  |
|-------------|----------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|--|
|             |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |  |
| North       |          |          |          |          | 3.5800     | 10.6334                        |          | 0.6300                            | 0.7000                             | 0.7700                       |          | 11.6339 (74)  |  |
| South       |          |          |          |          | 4.6200     | 46.7521                        |          | 0.6300                            | 0.7000                             | 0.7700                       |          | 66.0107 (78)  |  |
| West        |          |          |          |          | 0.5400     | 19.6403                        |          | 0.6300                            | 0.7000                             | 0.7700                       |          | 3.2413 (80)   |  |
|             |          |          |          |          |            |                                |          |                                   |                                    |                              |          |               |  |
| Solar gains | 80.8859  | 136.6822 | 185.9326 | 231.5560 | 262.6000   | 262.7033                       | 252.3982 | 228.5495                          | 201.4231                           | 150.5944                     | 96.6387  | 69.4034 (83)  |  |
| Total gains | 635.4137 | 704.3784 | 729.8972 | 757.2490 | 762.5175   | 742.7817                       | 714.6596 | 691.8852                          | 678.5278                           | 645.9951                     | 621.3711 | 612.9906 (84) |  |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 30.7290 | 30.8008 | 30.8715 | 31.2081 | 31.2719 | 31.5723 | 31.5723 | 31.6285 | 31.4559 | 31.2719 | 31.1431 | 31.0096      |
| alpha                                                                       | 3.0486  | 3.0534  | 3.0581  | 3.0805  | 3.0848  | 3.1048  | 3.1048  | 3.1086  | 3.0971  | 3.0848  | 3.0762  | 3.0673       |
| util living area                                                            | 0.9520  | 0.9332  | 0.9084  | 0.8554  | 0.7670  | 0.6231  | 0.4818  | 0.5125  | 0.6941  | 0.8571  | 0.9291  | 0.9564 (86)  |
| MIT                                                                         | 19.0501 | 19.2998 | 19.6408 | 20.1100 | 20.5241 | 20.8262 | 20.9421 | 20.9284 | 20.7417 | 20.2317 | 19.5806 | 19.0108 (87) |
| Th 2                                                                        | 20.0134 | 20.0155 | 20.0175 | 20.0271 | 20.0288 | 20.0372 | 20.0372 | 20.0387 | 20.0340 | 20.0288 | 20.0252 | 20.0214 (88) |
| util rest of house                                                          | 0.9445  | 0.9229  | 0.8937  | 0.8307  | 0.7247  | 0.5534  | 0.3885  | 0.4202  | 0.6307  | 0.8283  | 0.9165  | 0.9495 (89)  |
| MIT 2                                                                       | 17.7521 | 18.0662 | 18.4943 | 19.0778 | 19.5691 | 19.9019 | 20.0054 | 19.9970 | 19.8183 | 19.2349 | 18.4301 | 17.7078 (90) |
| Living area fraction                                                        | 17.9957 | 18.2977 | 18.7095 | 19.2715 | 19.7483 | 20.0753 | 20.1812 | 20.1718 | 19.9916 | 19.4220 | 18.6460 | 17.9523 (91) |
| MIT                                                                         | 17.9957 | 18.2977 | 18.7095 | 19.2715 | 19.7483 | 20.0753 | 20.1812 | 20.1718 | 19.9916 | 19.4220 | 18.6460 | 17.9523 (92) |
| Temperature adjustment                                                      | 17.9957 | 18.2977 | 18.7095 | 19.2715 | 19.7483 | 20.0753 | 20.1812 | 20.1718 | 19.9916 | 19.4220 | 18.6460 | 17.9523 (93) |

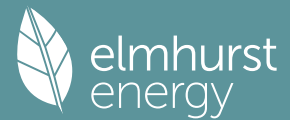
## 8. Space heating requirement

|                                                                                | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov           | Dec       |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|---------------|-----------|-------|
| Utilisation                                                                    | 0.9238    | 0.8997    | 0.8692    | 0.8082   | 0.7110   | 0.5564   | 0.4031   | 0.4336   | 0.6276   | 0.8068   | 0.8935        | 0.9299    | (94)  |
| Useful gains                                                                   | 586.9863  | 633.7186  | 634.4214  | 612.0070 | 542.1678 | 413.2840 | 288.0519 | 300.0141 | 425.8776 | 521.1956 | 555.1909      | 569.9899  | (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                                                               | 1179.4823 | 1151.1335 | 1046.6356 | 879.4921 | 681.0918 | 458.9428 | 300.1760 | 315.5915 | 495.6605 | 746.5657 | 981.1298      | 1173.6401 | (97)  |
| Space heating kWh                                                              | 440.8170  | 347.7028  | 306.6873  | 192.5893 | 103.3595 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 167.6754 | 306.6761      | 449.1157  | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |          |          |          |          |          |          |          |               | 2314.6231 |       |
| 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                                                              | 440.8170  | 347.7028  | 306.6873  | 192.5893 | 103.3595 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 167.6754 | 306.6761      | 449.1157  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |          |          |          |          |          |          |          |               | 2314.6231 |       |
| Space heating per m2                                                           |           |           |           |          |          |          |          |          |          |          | (98c) / (4) = | 29.1514   | (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 %)                      |          |          |          |          |        |        |        |        |        |          |          | 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                                             | Jan      | Feb      | Mar      | Apr      | May    | Jun    | Jul    | Aug    | Sep    | Oct      | Nov      | Dec           |
| 440.8170                                                              | 347.7028 | 306.6873 | 192.5893 | 103.3595 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 167.6754 | 306.6761 | 449.1157 (98) |
| Space heating efficiency (main heating system 1)                      |          |          |          |          |        |        |        |        |        |          |          |               |

# Full SAP Calculation Printout



|                                                                                                      |          |          |          |           |           |           |           |           |           |          |          |                  |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------------|
| Space heating fuel (main heating system)                                                             | 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)    |
| 477.5916                                                                                             | 376.7094 | 332.2723 | 208.6558 | 111.9821  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 181.6635 | 332.2601 | 486.5825 (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 requirement                                                                            | 232.1300 | 205.3091 | 218.4010 | 192.9691  | 187.6398  | 169.7324  | 168.1018  | 174.4864  | 176.0544  | 195.5064 | 206.8507 | 229.7433 (64)    |
| Efficiency of water heater (217)m                                                                    | 85.4747  | 85.2313  | 84.8211  | 84.0554   | 82.7800   | 79.8000   | 79.8000   | 79.8000   | 79.8000   | 83.7173  | 84.9412  | 79.8000 (216)    |
| Fuel for water heating, kWh/month                                                                    | 271.5773 | 240.8847 | 257.4843 | 229.5739  | 226.6729  | 212.6972  | 210.6539  | 218.6547  | 220.6196  | 233.5316 | 243.5222 | 85.5353 (217)    |
| 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)     |
| (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                                                                                         | 7.3041   | 6.5973   | 7.3041   | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685   | 7.3041   | 7.0685 (231)     |
| Lighting                                                                                             | 25.8663  | 20.7509  | 18.6839  | 13.6886   | 10.5735   | 8.6386    | 9.6455    | 12.5376   | 16.2850   | 21.3669  | 24.1338  | 26.5852 (232)    |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -37.0848 | -52.2376 | -75.0075 | -84.2301  | -90.7254  | -84.6417  | -83.6122  | -79.0098  | -70.8323  | -59.7180 | -40.7629 | -32.0686 (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)    |
| (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)                  | 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)    |
| (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) | 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)    |
| (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)                                        | -21.0438 | -44.2748 | -88.0162 | -132.2155 | -174.8415 | -175.6844 | -173.5997 | -146.9539 | -107.6821 | -63.2994 | -28.0911 | -16.6385 (233b)  |
| (233b)m                                                                                              | -21.0438 | -44.2748 | -88.0162 | -132.2155 | -174.8415 | -175.6844 | -173.5997 | -146.9539 | -107.6821 | -63.2994 | -28.0911 | -16.6385 (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)    |
| (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)                  | 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)    |
| (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) | 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)    |
| (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                                                                   |          |          |          |           |           |           |           |           |           |          |          | 2507.7173 (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                                                                              |          |          |          |           |           |           |           |           |           |          |          | 2834.4671 (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)                                                  |          |          |          |           |           |           |           |           |           |          |          | 208.7557 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |          |           |           |           |           |           |           |          |          |                  |
| PV generation                                                                                        |          |          |          |           |           |           |           |           |           |          |          | -1962.2720 (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                                                                  |          |          |          |           |           |           |           |           |           |          |          | 3674.6680 (238)  |

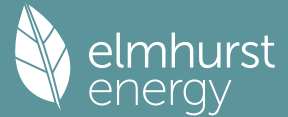
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 2507.7173          | 0.2100                        | 526.6206 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2834.4671          | 0.2100                        | 595.2381 (264)           |
| Space and water heating                       |                    |                               | 1121.8587 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 208.7557           | 0.1443                        | 30.1299 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -789.9309          | 0.1346                        | -106.3323                |
| PV Unit electricity exported                  | -1172.3411         | 0.1259                        | -147.5892                |
| Total                                         |                    |                               | -253.9214 (269)          |
| Total CO2, kg/year                            |                    |                               | 909.9965 (272)           |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 11.4600 (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               | 2507.7173          | 1.1300                              | 2833.7205 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2834.4671          | 1.1300                              | 3202.9478 (278)            |
| Space and water heating                     |                    |                                     | 6036.6683 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 208.7557           | 1.5338                              | 320.1964 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -789.9309          | 1.4975                              | -1182.9180                 |
| PV Unit electricity exported                | -1172.3411         | 0.4621                              | -541.7535                  |
| Total                                       |                    |                                     | -1724.6716 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 4762.2940 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 59.9800 (287)              |

# Full SAP Calculation Printout



|                                    |                        |               |       |                |            |
|------------------------------------|------------------------|---------------|-------|----------------|------------|
| Property Reference                 | 3710 3B5P              |               |       | Issued on Date | 22/11/2024 |
| Assessment Reference               | Fabric                 | Prop Type Ref |       |                |            |
| Property                           | B3710 3B5P,            |               |       |                |            |
|                                    |                        |               |       |                |            |
| SAP Rating                         | 82 B                   | DER           | 10.73 | TER            | 11.75      |
| Environmental                      | 91 B                   | % DER < TER   |       |                | 8.68       |
| CO <sub>2</sub> Emissions (t/year) | 0.91                   | DFEE          | 37.29 | TFEE           | 39.64      |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |                | 5.93       |
| % DPER < TPER                      | -9.52                  | DPER          | 67.48 | TPER           | 61.61      |
|                                    |                        |               |       |                |            |
| Assessor Details                   | Mr. Michael Woodbridge |               |       | Assessor ID    | M818-0001  |
| Client                             |                        |               |       |                |            |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 46.5000 (1b)              | x 2.5000 (2b)                   | = 116.2500 (1b) - (3b)      |
| First floor                                            | 46.5000 (1c)              | x 2.6000 (2c)                   | = 120.9000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 237.1500 (5)              |

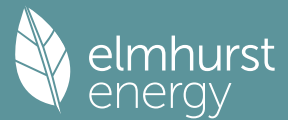
## 2. Ventilation rate

|                                                                                                         | 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                                                                                    | 4.0000 (17)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate                                                                                       | 0.2000 (18)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Number of sides sheltered                                                                               | 3 (19)                                                                          |            |            |            |            |            |            |            |            |            |            |                 |
| Shelter factor                                                                                          | (20) = 1 - [0.075 x (19)] = 0.7750 (20)                                         |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate adjusted to include shelter factor                                                    | (21) = (18) x (20) = 0.1550 (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                                                                                         | 0.1976                                                                          | 0.1938     | 0.1899     | 0.1705     | 0.1666     | 0.1473     | 0.1473     | 0.1434     | 0.1550     | 0.1666     | 0.1744     | 0.1821 (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) =            |                                                                                 |            |            |            |            |            |            |            |            |            |            | 70.3800 (23c)   |
| Effective ac                                                                                            | 0.3457                                                                          | 0.3419     | 0.3380     | 0.3186     | 0.3147     | 0.2954     | 0.2954     | 0.2915     | 0.3031     | 0.3147     | 0.3225     | 0.3302 (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   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| W1 (Uw = 0.80)                                              |                         |                            | 2.6400                    | 0.7752                        | 2.0465       |                                | (27)            |
| W2 (Uw = 0.80)                                              |                         |                            | 1.4400                    | 0.7752                        | 1.1163       |                                | (27)            |
| W3 (Uw = 0.80)                                              |                         |                            | 1.0800                    | 0.7752                        | 0.8372       |                                | (27)            |
| W4 (Uw = 0.80)                                              |                         |                            | 2.3800                    | 0.7752                        | 1.8450       |                                | (27)            |
| W5 (Uw = 0.80)                                              |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| W6 (Uw = 0.80)                                              |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| Front Door                                                  |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26)            |
| Rear door                                                   |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26a)           |
| Ground floor                                                |                         |                            | 46.5000                   | 0.1200                        | 5.5800       | 110.0000                       | 5115.0000 (28a) |
| External Walls                                              | 151.3170                | 13.1200                    | 138.1970                  | 0.1500                        | 20.7296      | 9.0000                         | 1243.7730 (29a) |
| Roof at ceiling                                             | 46.5000                 |                            | 46.5000                   | 0.1100                        | 5.1150       | 9.0000                         | 418.5000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 244.3170                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            | (26)...(30) + (32) =      |                               | 42.6067      |                                | (33)            |
| Internal Walls                                              |                         |                            | 197.7520                  |                               |              | 9.0000                         | 1779.7680 (32c) |

# Full SAP Calculation Printout



|                  |         |         |                |
|------------------|---------|---------|----------------|
| Internal floor   | 46.5000 | 18.0000 | 837.0000 (32d) |
| Internal ceiling | 46.5000 | 9.0000  | 418.5000 (32e) |

Heat capacity  $C_m = \text{Sum}(A \times k)$  (28)...(30) + (32) + (32a)...(32e) = 9812.5410 (34)  
 Thermal mass parameter (TMP =  $C_m / \text{TFA}$ ) in kJ/m<sup>2</sup>K 105.5112 (35)

## List of Thermal Bridges

| K1 Element                                                                | Length  | Psi-value | Total   |
|---------------------------------------------------------------------------|---------|-----------|---------|
| E2 Other lintels (including other steel lintels)                          | 11.6600 | 0.3000    | 3.4980  |
| E3 Sill                                                                   | 9.5200  | 0.0400    | 0.3808  |
| E4 Jamb                                                                   | 27.9000 | 0.0500    | 1.3950  |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0700    | 0.0000  |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.1000    | 0.0000  |
| E14 Flat roof                                                             | 0.0000  | 0.1600    | 0.0000  |
| E16 Corner (normal)                                                       | 20.4000 | 0.0900    | 1.8360  |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000  | -0.0900   | -0.0000 |
| E18 Party wall between dwellings                                          | 0.0000  | 0.0600    | 0.0000  |
| E25 Staggered party wall between dwellings                                | 0.0000  | 0.2400    | 0.0000  |
| E5 Ground floor (normal)                                                  | 29.7300 | 0.1600    | 4.7568  |
| E6 Intermediate floor within a dwelling                                   | 29.7300 | 0.0700    | 2.0811  |
| E10 Eaves (insulation at ceiling level)                                   | 7.4300  | 0.0600    | 0.4458  |
| E12 Gable (insulation at ceiling level)                                   | 16.4000 | 0.2400    | 3.9360  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000  | 0.0340    | 0.0000  |
| P1 Party wall - Ground floor                                              | 0.0000  | 0.3200    | 0.0000  |
| P2 Party wall - Intermediate floor within a dwelling                      | 0.0000  | 0.0000    | 0.0000  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 18.3295 (36)  
 Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 60.9362 (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       | 27.0563 | 26.7530 | 26.4498 | 24.9335 | 24.6302 | 23.1139 | 23.1139 | 22.8107 | 23.7205 | 24.6302 | 25.2367 | 25.8432 (38) |
| Average = Sum(39)m / 12 = | 87.9925 | 87.6892 | 87.3860 | 85.8697 | 85.5664 | 84.0502 | 84.0502 | 83.7469 | 84.6567 | 85.5664 | 86.1730 | 86.7795 (39) |
|                           |         |         |         |         |         |         |         |         |         |         |         | 85.7939      |
| HLP                       | 0.9462  | 0.9429  | 0.9396  | 0.9233  | 0.9201  | 0.9038  | 0.9038  | 0.9005  | 0.9103  | 0.9201  | 0.9266  | 0.9331 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9225       |
| Days in mont              | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31           |

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

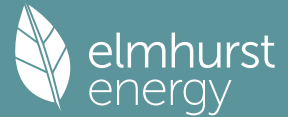
|                                                                                |          |          |          |          |         |         |         |         |         |          |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|----------------|
| Assumed occupancy                                                              |          |          |          |          |         |         |         |         |         |          |          | 2.6646 (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                                                      | 29.7509  | 29.3090  | 28.6868  | 27.5396  | 26.6806 | 25.7280 | 25.2135 | 25.8314 | 26.5041 | 27.5233  | 28.6942  | 29.6503 (42b)  |
| Hot water usage for other uses                                                 | 41.9181  | 40.3938  | 38.8695  | 37.3453  | 35.8210 | 34.2967 | 34.2967 | 35.8210 | 37.3453 | 38.8695  | 40.3938  | 41.9181 (42c)  |
| Average daily hot water use (litres/day)                                       |          |          |          |          |         |         |         |         |         |          |          | 65.6912 (43)   |
| Daily hot water use                                                            | 71.6690  | 69.7029  | 67.5564  | 64.8849  | 62.5015 | 60.0247 | 59.5102 | 61.6523 | 63.8493 | 66.3929  | 69.0881  | 71.5684 (44)   |
| Energy content (annual)                                                        | 113.5062 | 99.2560  | 103.8316 | 88.8241  | 84.1391 | 73.8074 | 71.9724 | 76.3385 | 78.7326 | 90.0945  | 98.4286  | 112.0589 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                                         | 17.0259  | 14.8884  | 15.5747  | 13.3236  | 12.6209 | 11.0711 | 10.7959 | 11.4508 | 11.8099 | 13.5142  | 14.7643  | 16.8088 (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                                                                     | 13.9518  | 12.5913  | 13.9249  | 13.4511  | 13.8828 | 13.4191 | 13.8594 | 13.8695 | 13.4334 | 13.9001  | 13.4760  | 13.9490 (61)   |
| Total heat required for water heating calculated for each month                | 127.4580 | 111.8473 | 117.7566 | 102.2752 | 98.0218 | 87.2265 | 85.8317 | 90.2080 | 92.1661 | 103.9946 | 111.9046 | 126.0079 (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                                                                | 127.4580 | 111.8473 | 117.7566 | 102.2752 | 98.0218 | 87.2265 | 85.8317 | 90.2080 | 92.1661 | 103.9946 | 111.9046 | 126.0079 (64)  |
| 12Total per year (kWh/year)                                                    |          |          |          |          |         |         |         |         |         |          |          | 1254.6984 (64) |
| Electric shower(s)                                                             | 55.1745  | 49.1609  | 53.6818  | 51.2279  | 52.1892 | 49.7834 | 51.4428 | 52.1892 | 51.2279 | 53.6818  | 52.6724  | 55.1745 (64a)  |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |         |         |         |         |         |          |          | 627.6062 (64a) |
| Heat gains from water heating, kWh/month                                       | 55.0224  | 48.4407  | 51.4257  | 45.7038  | 44.4942 | 40.3416 | 40.2564 | 41.8972 | 42.3439 | 46.8519  | 49.2646  | 54.5405 (65)   |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
| (66)m                                                                               | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 144.6496  | 160.1478  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 244.4900  | 247.0270  | 240.6338  | 227.0233  | 209.8424  | 193.6949  | 182.9074  | 180.3703  | 186.7636  | 200.3741  | 217.5549  | 233.7024 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 (71) |
| Water heating gains (Table 5)                                                       | 73.9548   | 72.0843   | 69.1206   | 63.4775   | 59.8041   | 56.0300   | 54.1080   | 56.3135   | 58.8110   | 62.9730   | 68.4231   | 73.3071 (72)   |
| Total internal gains                                                                | 529.0633  | 545.2280  | 520.3729  | 505.9409  | 480.2650  | 462.1651  | 444.6339  | 444.3023  | 458.0148  | 473.9656  | 501.4181  | 517.6280 (73)  |

## 6. Solar gains

# Full SAP Calculation Printout



| [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   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Southwest | 2.6400     | 36.7938                        | 0.6300                            | 0.0000                             | 0.7700                       | 47.1205 (79) |
| Southwest | 1.4400     | 36.7938                        | 0.6300                            | 0.0000                             | 0.7700                       | 25.7021 (79) |
| Northeast | 1.0800     | 11.2829                        | 0.6300                            | 0.0000                             | 0.7700                       | 5.9112 (75)  |
| Northeast | 2.3800     | 11.2829                        | 0.6300                            | 0.0000                             | 0.7700                       | 13.0266 (75) |
| Southeast | 0.5400     | 36.7938                        | 0.6300                            | 0.0000                             | 0.7700                       | 9.6383 (77)  |
| Northwest | 0.5400     | 11.2829                        | 0.6300                            | 0.0000                             | 0.7700                       | 2.9556 (81)  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 104.3544 | 185.0262 | 272.4769 | 369.9887 | 443.9701 | 453.7584 | 432.0620 | 374.8813 | 305.9326 | 209.7014 | 126.3168 | 88.4486 (83)  |
| Total gains | 633.4177 | 730.2542 | 792.8498 | 875.9296 | 924.2351 | 915.9235 | 876.6959 | 819.1836 | 763.9474 | 683.6671 | 627.7349 | 606.0767 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 30.9766                   | 31.0837 | 31.1916 | 31.7423 | 31.8548 | 32.4295 | 32.4295 | 32.5469 | 32.1972 | 31.8548 | 31.6306 | 31.4096      |
| alpha                                                                       | 3.0651                    | 3.0722  | 3.0794  | 3.1162  | 3.1237  | 3.1620  | 3.1620  | 3.1698  | 3.1465  | 3.1237  | 3.1087  | 3.0940       |
| util living area                                                            | 0.9554                    | 0.9316  | 0.8964  | 0.8174  | 0.6982  | 0.5367  | 0.4055  | 0.4465  | 0.6494  | 0.8465  | 0.9313  | 0.9603 (86)  |
| MIT                                                                         | 19.0310                   | 19.3317 | 19.7294 | 20.2579 | 20.6539 | 20.8929 | 20.9668 | 20.9548 | 20.7969 | 20.2845 | 19.5932 | 18.9952 (87) |
| Th 2                                                                        | 20.1284                   | 20.1312 | 20.1339 | 20.1477 | 20.1505 | 20.1643 | 20.1643 | 20.1671 | 20.1588 | 20.1505 | 20.1450 | 20.1394 (88) |
| util rest of house                                                          | 0.9492                    | 0.9224  | 0.8822  | 0.7927  | 0.6581  | 0.4788  | 0.3341  | 0.3734  | 0.5935  | 0.8203  | 0.9206  | 0.9547 (89)  |
| MIT 2                                                                       | 17.8146                   | 18.1938 | 18.6924 | 19.3475 | 19.8116 | 20.0779 | 20.1444 | 20.1385 | 19.9825 | 19.3939 | 18.5368 | 17.7764 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.0448                   | 18.4091 | 18.8887 | 19.5198 | 19.9710 | 20.2321 | 20.3001 | 20.2930 | 20.1366 | 19.5625 | 18.7368 | 18.0070 (92) |
| Temperature adjustment                                                      |                           |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 17.8948                   | 18.2591 | 18.7387 | 19.3698 | 19.8210 | 20.0821 | 20.1501 | 20.1430 | 19.9866 | 19.4125 | 18.5868 | 17.8570 (93) |

## 8. Space heating requirement

|                                                                                |                            |           |           |          |          |          |          |          |          |          |          |                |
|--------------------------------------------------------------------------------|----------------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
|                                                                                | Jan                        | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Utilisation                                                                    | 0.9275                     | 0.8968    | 0.8540    | 0.7668   | 0.6412   | 0.4729   | 0.3328   | 0.3712   | 0.5811   | 0.7932   | 0.8950   | 0.9344 (94)    |
| Useful gains                                                                   | 587.5046                   | 654.8641  | 677.1263  | 671.6791 | 592.5809 | 433.1071 | 291.7927 | 304.0837 | 443.9044 | 542.3089 | 561.8527 | 566.3387 (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                                                               | 1196.2428                  | 1171.4514 | 1069.4870 | 899.0360 | 694.8833 | 460.7748 | 298.3841 | 313.4656 | 498.3393 | 754.0501 | 989.8477 | 1185.1506 (97) |
| Space heating kWh                                                              | 452.9012                   | 347.1466  | 291.9163  | 163.6970 | 76.1130  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 157.5355 | 308.1564 | 460.3961 (98a) |
| Space heating requirement - total per year (kWh/year)                          | 2257.8621                  |           |           |          |          |          |          |          |          |          |          |                |
| 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                                                              | 452.9012                   | 347.1466  | 291.9163  | 163.6970 | 76.1130  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 157.5355 | 308.1564 | 460.3961 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | 2257.8621                  |           |           |          |          |          |          |          |          |          |          |                |
| Space heating per m2                                                           | (98c) / (4) = 24.2781 (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 %)                                                             |          |          |          |          |          |         |         |          |          |          |          | 89.0000 (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                                                                                    | 452.9012 | 347.1466 | 291.9163 | 163.6970 | 76.1130  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 157.5355 | 308.1564 | 460.3961 (98)  |
| Space heating efficiency (main heating system 1)                                                             | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 89.0000  | 89.0000  | 89.0000 (210)  |
| Space heating fuel (main heating system)                                                                     | 508.8778 | 390.0524 | 327.9959 | 183.9292 | 85.5202  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 177.0062 | 346.2431 | 517.2990 (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                                                                                    | 127.4580 | 111.8473 | 117.7566 | 102.2752 | 98.0218  | 87.2265 | 85.8317 | 90.2080  | 92.1661  | 103.9946 | 111.9046 | 126.0079 (64)  |
| Efficiency of water heater (217)m                                                                            | 88.6210  | 88.5797  | 88.5046  | 88.3385  | 88.0350  | 87.3000 | 87.3000 | 87.3000  | 87.3000  | 88.3161  | 88.5407  | 87.3000 (216)  |
| Fuel for water heating, kWh/month                                                                            | 143.8237 | 126.2675 | 133.0513 | 115.7765 | 111.3442 | 99.9158 | 98.3182 | 103.3310 | 105.5740 | 117.7527 | 126.3878 | 142.1744 (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                                                                                                 | 22.6620  | 20.4689  | 22.6620  | 21.9310  | 22.6620  | 21.9310 | 22.6620 | 22.6620  | 21.9310  | 22.6620  | 21.9310  | 22.6620 (231)  |
| Lighting                                                                                                     | 35.9975  | 28.8785  | 26.0019  | 19.0501  | 14.7149  | 12.0222 | 13.4234 | 17.4482  | 22.6635  | 29.7358  | 33.5865  | 36.9980 (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)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 (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                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (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)                          |          |          |          |          |          |         |         |          |          |          |          |                |

# Full SAP Calculation Printout



|                                                                                                      |        |        |        |        |        |        |        |        |        |        |        |           |        |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| (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                                                                   |        |        |        |        |        |        |        |        |        |        |        | 2536.9238 | (211)  |
| Space heating fuel - main system 2                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (213)  |
| Space heating fuel - secondary                                                                       |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (215)  |
| Efficiency of water heater                                                                           |        |        |        |        |        |        |        |        |        |        |        | 87.3000   |        |
| Water heating fuel used                                                                              |        |        |        |        |        |        |        |        |        |        |        | 1423.7169 | (219)  |
| Space cooling fuel                                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (221)  |
| Electricity for pumps and fans:                                                                      |        |        |        |        |        |        |        |        |        |        |        |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)                           |        |        |        |        |        |        |        |        |        |        |        |           |        |
| mechanical ventilation fans (SFP = 0.6250)                                                           |        |        |        |        |        |        |        |        |        |        |        | 180.8269  | (230a) |
| central heating pump                                                                                 |        |        |        |        |        |        |        |        |        |        |        | 41.0000   | (230c) |
| main heating flue fan                                                                                |        |        |        |        |        |        |        |        |        |        |        | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                                                            |        |        |        |        |        |        |        |        |        |        |        | 266.8269  | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                  |        |        |        |        |        |        |        |        |        |        |        | 290.5204  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |        |        |        |        |        |        |        |        |        |        |        |           |        |
| PV generation                                                                                        |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (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                                                                  |        |        |        |        |        |        |        |        |        |        |        | 5145.5942 | (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                   | 2536.9238          | 0.2100                        | 532.7540                 | (261)  |
| Total CO2 associated with community systems     |                    |                               | 0.0000                   | (373)  |
| Water heating (other fuel)                      | 1423.7169          | 0.2100                        | 298.9806                 | (264)  |
| Energy for instantaneous electric shower(s)     | 627.6062           | 0.1391                        | 87.3139                  | (264a) |
| Space and water heating                         |                    |                               | 831.7345                 | (265)  |
| Pumps, fans and electric keep-hot               | 266.8269           | 0.1387                        | 37.0122                  | (267)  |
| Energy for lighting                             | 290.5204           | 0.1443                        | 41.9311                  | (268)  |
| Total CO2, kg/year                              |                    |                               | 997.9917                 | (272)  |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 10.7300                  | (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               | 2536.9238          | 1.1300                              | 2866.7238                  | (275)  |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473)  |
| Water heating (other fuel)                  | 1423.7169          | 1.1300                              | 1608.8001                  | (278)  |
| Energy for instantaneous electric shower(s) | 627.6062           | 1.5143                              | 950.4055                   | (278a) |
| Space and water heating                     |                    |                                     | 4475.5240                  | (279)  |
| Pumps, fans and electric keep-hot           | 266.8269           | 1.5128                              | 403.6557                   | (281)  |
| Energy for lighting                         | 290.5204           | 1.5338                              | 445.6100                   | (282)  |
| Total Primary energy kWh/year               |                    |                                     | 6275.1951                  | (286)  |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 67.4800                    | (287)  |

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

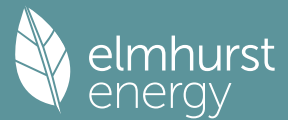
### 1. Overall dwelling characteristics

|                                                         | Area<br>(m2) | Storey height<br>(m)             | Volume<br>(m3)         |     |
|---------------------------------------------------------|--------------|----------------------------------|------------------------|-----|
| Ground floor                                            | 46.5000 (1b) | x 2.5000 (2b)                    | = 116.2500 (1b) - (3b) |     |
| First floor                                             | 46.5000 (1c) | x 2.6000 (2c)                    | = 120.9000 (1c) - (3c) |     |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)... (1n) | 93.0000      |                                  |                        | (4) |
| Dwelling volume                                         |              | (3a)+(3b)+(3c)+(3d)+(3e)... (3n) | = 237.1500             | (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) = | 0.1265 (8)   |
| Pressure test                                                                                      | Yes             |              |
| Pressure Test Method                                                                               | Blower Door     |              |
| Measured/design AP50                                                                               | 5.0000          | (17)         |
| Infiltration rate                                                                                  | 0.3765          | (18)         |
| Number of sides sheltered                                                                          | 3               | (19)         |

# Full SAP Calculation Printout



Shelter factor  
Infiltration rate adjusted to include shelter factor

$$(20) = 1 - [0.075 \times (19)] = 0.7750 \quad (20)$$

$$(21) = (18) \times (20) = 0.2918 \quad (21)$$

|                 | 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 | 0.3720 | 0.3647 | 0.3574 | 0.3210 | 0.3137 | 0.2772 | 0.2772 | 0.2699 | 0.2918 | 0.3137 | 0.3283 | 0.3429 | (22b) |
| Effective ac    | 0.5692 | 0.5665 | 0.5639 | 0.5515 | 0.5492 | 0.5384 | 0.5384 | 0.5364 | 0.5426 | 0.5492 | 0.5539 | 0.5588 | (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                                |             |                | 2.2500        | 1.0000           | 2.2500       |                   |               | (26)                         |
| TER Semi-glazed door                           |             |                | 2.2500        | 1.0000           | 2.2500       |                   |               | (26a)                        |
| TER Opening Type (Uw = 1.20)                   |             |                | 8.6200        | 1.1450           | 9.8702       |                   |               | (27)                         |
| Ground floor                                   |             |                | 46.5000       | 0.1300           | 6.0450       |                   |               | (28a)                        |
| External Walls                                 | 151.3170    | 13.1200        | 138.1970      | 0.1800           | 24.8755      |                   |               | (29a)                        |
| Roof at ceiling                                | 46.5000     |                | 46.5000       | 0.1100           | 5.1150       |                   |               | (30)                         |
| Total net area of external elements Aum(A, m2) |             |                | 244.3170      |                  |              |                   |               | (31)                         |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               |                  |              |                   |               | (33)                         |
|                                                |             |                |               |                  |              |                   |               | (26)...(30) + (32) = 50.4057 |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

105.5112 (35)

List of Thermal Bridges

| K1 Element                                                                | Length  | Psi-value | Total   |                                    |
|---------------------------------------------------------------------------|---------|-----------|---------|------------------------------------|
| E2 Other lintels (including other steel lintels)                          | 11.6600 | 0.0500    | 0.5830  |                                    |
| E3 Sill                                                                   | 9.5200  | 0.0500    | 0.4760  |                                    |
| E4 Jamb                                                                   | 27.9000 | 0.0500    | 1.3950  |                                    |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0700    | 0.0000  |                                    |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.0000    | 0.0000  |                                    |
| E14 Flat roof                                                             | 0.0000  | 0.0800    | 0.0000  |                                    |
| E16 Corner (normal)                                                       | 20.4000 | 0.0900    | 1.8360  |                                    |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000  | -0.0900   | -0.0000 |                                    |
| E18 Party wall between dwellings                                          | 0.0000  | 0.0600    | 0.0000  |                                    |
| E25 Staggered party wall between dwellings                                | 0.0000  | 0.0600    | 0.0000  |                                    |
| E5 Ground floor (normal)                                                  | 29.7300 | 0.1600    | 4.7568  |                                    |
| E6 Intermediate floor within a dwelling                                   | 29.7300 | 0.0000    | 0.0000  |                                    |
| E10 Eaves (insulation at ceiling level)                                   | 7.4300  | 0.0600    | 0.4458  |                                    |
| E12 Gable (insulation at ceiling level)                                   | 16.4000 | 0.0600    | 0.9840  |                                    |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000  |                                    |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000  | 0.1200    | 0.0000  |                                    |
| P1 Party wall - Ground floor                                              | 0.0000  | 0.0800    | 0.0000  |                                    |
| P2 Party wall - Intermediate floor within a dwelling                      | 0.0000  | 0.0000    | 0.0000  |                                    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |           |         | 10.4766 (36)                       |
| Point Thermal bridges                                                     |         |           |         | (36a) = 0.0000                     |
| Total fabric heat loss                                                    |         |           |         | (33) + (36) + (36a) = 60.8823 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

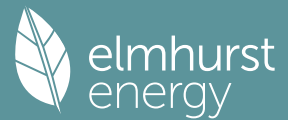
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |          |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| (38)m                     | 44.5456  | 44.3353  | 44.1291  | 43.1609  | 42.9798  | 42.1365  | 42.1365  | 41.9803  | 42.4613  | 42.9798  | 43.3462  | 43.7294  | (38)     |
| Heat transfer coeff       | 105.4279 | 105.2176 | 105.0114 | 104.0432 | 103.8621 | 103.0188 | 103.0188 | 102.8626 | 103.3436 | 103.8621 | 104.2285 | 104.6117 | (39)     |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          |          | 104.0423 |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| HLP           | 1.1336 | 1.1314 | 1.1292 | 1.1187 | 1.1168 | 1.1077 | 1.1077 | 1.1060 | 1.1112 | 1.1168 | 1.1207 | 1.1249 | (40)   |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        |        | 1.1187 |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |        |

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

| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          |          | 2.6646 (42)    |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Hot water usage for mixer showers                                              |          |          |          |          |          |          |          |          |          |          |          |          | 68.6323 (42a)  |
| Hot water usage for baths                                                      |          |          |          |          |          |          |          |          |          |          |          |          | 29.6503 (42b)  |
| Hot water usage for other uses                                                 |          |          |          |          |          |          |          |          |          |          |          |          | 41.9181 (42c)  |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          |          | 129.2112 (43)  |
|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                |
| Daily hot water use                                                            | 140.5653 | 137.5638 | 133.9086 | 128.3503 | 123.8366 | 118.9841 | 117.1192 | 120.7587 | 124.5971 | 129.6914 | 135.3353 | 140.2008 | (44)           |
| Energy conte                                                                   | 222.6211 | 195.8890 | 205.8125 | 175.7052 | 166.7079 | 146.3048 | 141.6456 | 149.5245 | 153.6407 | 175.9900 | 192.8100 | 219.5205 | (45)           |
| Energy content (annual)                                                        |          |          |          |          |          |          |          |          |          |          |          |          | 2146.1718      |
| Distribution loss (46)m = 0.15 x (45)m                                         |          |          |          |          |          |          |          |          |          |          |          |          |                |
|                                                                                | 33.3932  | 29.3834  | 30.8719  | 26.3558  | 25.0062  | 21.9457  | 21.2468  | 22.4287  | 23.0461  | 26.3985  | 28.9215  | 32.9281  | (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                                                                     | 50.9589  | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | (61)           |
| Total heat required for water heating calculated for each month                |          |          |          |          |          |          |          |          |          |          |          |          |                |
| WWHRS                                                                          | 273.5800 | 241.9164 | 256.7714 | 225.0202 | 217.6668 | 195.6199 | 192.6045 | 200.4834 | 202.9557 | 226.9489 | 242.1250 | 270.4794 | (62)           |
| PV diverter                                                                    | -31.4965 | -27.8558 | -29.1690 | -24.1531 | -22.5098 | -19.2618 | -18.0548 | -19.1995 | -19.9290 | -23.4941 | -26.6159 | -30.9132 | (63a)          |
| 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  | (63b)          |
| 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   | (63c)          |
| Output from w/h                                                                | 242.0835 | 214.0607 | 227.6024 | 200.8672 | 195.1571 | 176.3581 | 174.5496 | 181.2839 | 183.0268 | 203.4549 | 215.5091 | 239.5662 | (64)           |
| Total per year (kWh/year)                                                      |          |          |          |          |          |          |          |          |          |          |          |          | 2453.5194 (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                                       | 86.7612  | 76.6400  | 81.1724  | 70.7507  | 68.1701  | 60.9751  | 59.8369  | 62.4566  | 63.4143  | 71.2564  | 76.4381  | 85.7303  | (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                                                                               | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 144.6496  | 160.1478  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 244.4900  | 247.0270  | 240.6338  | 227.0233  | 209.8424  | 193.6949  | 182.9074  | 180.3703  | 186.7636  | 200.3741  | 217.5549  | 233.7024 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230 (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    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 (71) |
| Water heating gains (Table 5)                                                       | 116.6146  | 114.0475  | 109.1026  | 98.2649   | 91.6265   | 84.6877   | 80.4259   | 83.9471   | 88.0754   | 95.7748   | 106.1640  | 115.2289 (72)  |
| Total internal gains                                                                | 571.7231  | 587.1913  | 560.3549  | 540.7284  | 512.0875  | 490.8228  | 470.9518  | 471.9359  | 487.2792  | 506.7674  | 539.1591  | 559.5499 (73)  |

## 6. Solar gains

| [Jan]       | Area<br>m <sup>2</sup> |          | Solar flux<br>Table 6a<br>W/m <sup>2</sup> |          | Specific data<br>or Table 6b |          | Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|------------------------|----------|--------------------------------------------|----------|------------------------------|----------|------------------------------|----------|------------------------------|----------|--------------|---------------|
| Northeast   | 3.4600                 |          | 11.2829                                    |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 11.9308 (75) |               |
| Southeast   | 0.5400                 |          | 36.7938                                    |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 6.0721 (77)  |               |
| Southwest   | 4.0800                 |          | 36.7938                                    |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 45.8783 (79) |               |
| Northwest   | 0.5400                 |          | 11.2829                                    |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 1.8620 (81)  |               |
| Solar gains | 65.7432                | 116.5665 | 171.6605                                   | 233.0929 | 279.7011                     | 285.8678 | 272.1990                     | 236.1752 | 192.7375                     | 132.1119 | 79.5796      | 55.7226 (83)  |
| Total gains | 637.4663               | 703.7578 | 732.0154                                   | 773.8212 | 791.7886                     | 776.6906 | 743.1509                     | 708.1111 | 680.0167                     | 638.8793 | 618.7387     | 615.2725 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 25.8537 | 25.9054 | 25.9563 | 26.1978 | 26.2435 | 26.4583 | 26.4583 | 26.4985 | 26.3752 | 26.2435 | 26.1512 | 26.0555      |
| alpha                                                                       | 2.7236  | 2.7270  | 2.7304  | 2.7465  | 2.7496  | 2.7639  | 2.7639  | 2.7666  | 2.7583  | 2.7496  | 2.7434  | 2.7370       |
| util living area                                                            | 0.9590  | 0.9446  | 0.9248  | 0.8793  | 0.8014  | 0.6717  | 0.5381  | 0.5752  | 0.7511  | 0.8879  | 0.9421  | 0.9625 (86)  |
| MIT                                                                         | 18.5472 | 18.8019 | 19.1925 | 19.7592 | 20.2887 | 20.7037 | 20.8851 | 20.8581 | 20.5650 | 19.8992 | 19.1441 | 18.5059 (87) |
| Th 2                                                                        | 19.9735 | 19.9753 | 19.9771 | 19.9856 | 19.9871 | 19.9945 | 19.9945 | 19.9959 | 19.9917 | 19.9871 | 19.9839 | 19.9806 (88) |
| util rest of house                                                          | 0.9528  | 0.9363  | 0.9127  | 0.8583  | 0.7631  | 0.6029  | 0.4376  | 0.4770  | 0.6922  | 0.8644  | 0.9319  | 0.9568 (89)  |
| MIT 2                                                                       | 17.1116 | 17.4341 | 17.9281 | 18.6391 | 19.2808 | 19.7528 | 19.9269 | 19.9072 | 19.6104 | 18.8229 | 17.8764 | 17.0634 (90) |
| Living area fraction                                                        | 17.3833 | 17.6929 | 18.1674 | 18.8510 | 19.4715 | 19.9328 | 20.1082 | 20.0872 | 19.7911 | 19.0266 | 18.1163 | 17.3364 (92) |
| MIT                                                                         | 17.3833 | 17.6929 | 18.1674 | 18.8510 | 19.4715 | 19.9328 | 20.1082 | 20.0872 | 19.7911 | 19.0266 | 18.1163 | 17.3364 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 17.3833 | 17.6929 | 18.1674 | 18.8510 | 19.4715 | 19.9328 | 20.1082 | 20.0872 | 19.7911 | 19.0266 | 18.1163 | 17.3364 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |          |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
| Utilisation                                                                    | 0.9304    | 0.9106    | 0.8844    | 0.8290    | 0.7403   | 0.5982   | 0.4498   | 0.4867   | 0.6787   | 0.8360   | 0.9062    | 0.9356 (94)    |
| Useful gains                                                                   | 593.0675  | 640.8596  | 647.4282  | 641.5128  | 586.1726 | 464.5989 | 334.2985 | 344.6670 | 461.5032 | 534.0718 | 560.6801  | 575.6319 (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                                                               | 1379.3468 | 1346.0421 | 1225.2114 | 1035.3383 | 807.1649 | 549.3741 | 361.4123 | 379.2710 | 588.1346 | 875.2043 | 1148.2156 | 1374.2201 (97) |
| Space heating kWh                                                              | 584.9918  | 473.8827  | 429.8707  | 283.5544  | 164.4183 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 253.8026 | 423.0256  | 594.1497 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |          |           | 3207.6956      |
| 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                                                              | 584.9918  | 473.8827  | 429.8707  | 283.5544  | 164.4183 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 253.8026 | 423.0256  | 594.1497 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |          |           | 3207.6956      |
| Space heating per m <sup>2</sup>                                               |           |           |           |           |          |          |          |          |          |          |           | 34.4914 (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 %)                      |          |          |          |          |          |        |        |        |        |          |          | 92.4000 (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                                             | 584.9918 | 473.8827 | 429.8707 | 283.5544 | 164.4183 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 253.8026 | 423.0256 | 594.1497 (98)  |
| Space heating efficiency (main heating system 1)                      | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.4000  | 92.4000  | 92.4000 (210)  |
| Space heating fuel (main heating system)                              | 633.1080 | 512.8601 | 465.2280 | 306.8770 | 177.9419 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 274.6781 | 457.8199 | 643.0191 (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

# Full SAP Calculation Printout



|                                                                                                      |          |          |           |           |           |           |           |           |           |          |          |                  |
|------------------------------------------------------------------------------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------------|
| Water heating requirement                                                                            | 242.0835 | 214.0607 | 227.6024  | 200.8672  | 195.1571  | 176.3581  | 174.5496  | 181.2839  | 183.0268  | 203.4549 | 215.5091 | 239.5662 (64)    |
| Efficiency of water heater                                                                           |          |          |           |           |           |           |           |           |           |          |          | 80.3000 (216)    |
| (217)m                                                                                               | 86.1979  | 86.0330  | 85.7219   | 85.1199   | 84.0164   | 80.3000   | 80.3000   | 80.3000   | 80.3000   | 84.8563  | 85.7987  | 86.2458 (217)    |
| Fuel for water heating, kWh/month                                                                    | 280.8461 | 248.8123 | 265.5127  | 235.9814  | 232.2845  | 219.6241  | 217.3719  | 225.7583  | 227.9287  | 239.7639 | 251.1799 | 277.7713 (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                                                                                         | 7.3041   | 6.5973   | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041   | 7.0685   | 7.3041 (231)     |
| Lighting                                                                                             | 30.0553  | 24.1115  | 21.7097   | 15.9055   | 12.2858   | 10.0376   | 11.2076   | 14.5680   | 18.9224   | 24.8272  | 28.0423  | 30.8907 (232)    |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |           |           |           |           |           |           |           |          |          |                  |
| (233a)m                                                                                              | -42.9488 | -60.2409 | -86.1180  | -96.2428  | -103.2470 | -96.1468  | -94.9618  | -89.9398  | -80.9511  | -68.6474 | -47.1123 | -37.1684 (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                                                                                              | -25.1363 | -52.8027 | -104.8291 | -157.2766 | -207.8075 | -208.7691 | -206.3065 | -174.7280 | -128.1401 | -75.4410 | -33.5352 | -19.8815 (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                                                                   |          |          |           |           |           |           |           |           |           |          |          | 3471.5320 (211)  |
| Space heating fuel - main system 2                                                                   |          |          |           |           |           |           |           |           |           |          |          | 0.0000 (213)     |
| Space heating fuel - secondary                                                                       |          |          |           |           |           |           |           |           |           |          |          | 0.0000 (215)     |
| Efficiency of water heater                                                                           |          |          |           |           |           |           |           |           |           |          |          | 80.3000          |
| Water heating fuel used                                                                              |          |          |           |           |           |           |           |           |           |          |          | 2922.8352 (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)                                                  |          |          |           |           |           |           |           |           |           |          |          | 242.5637 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |           |           |           |           |           |           |           |          |          |                  |
| PV generation                                                                                        |          |          |           |           |           |           |           |           |           |          |          | -2298.3790 (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                                                                  |          |          |           |           |           |           |           |           |           |          |          | 4424.5519 (238)  |

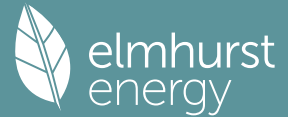
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 3471.5320          | 0.2100                        | 729.0217 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2922.8352          | 0.2100                        | 613.7954 (264)           |
| Space and water heating                       |                    |                               | 1342.8171 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 242.5637           | 0.1443                        | 35.0094 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -903.7252          | 0.1347                        | -121.7427                |
| PV Unit electricity exported                  | -1394.6538         | 0.1259                        | -175.6246                |
| Total                                         |                    |                               | -297.3674 (269)          |
| Total CO2, kg/year                            |                    |                               | 1092.3885 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 11.7500 (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               | 3471.5320          | 1.1300                              | 3922.8312 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2922.8352          | 1.1300                              | 3302.8038 (278)            |
| Space and water heating                     |                    |                                     | 7225.6350 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 242.5637           | 1.5338                              | 372.0523 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -903.7252          | 1.4979                              | -1353.6722                 |
| PV Unit electricity exported                | -1394.6538         | 0.4622                              | -644.6649                  |
| Total                                       |                    |                                     | -1998.3371 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 5729.4509 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 61.6100 (287)              |

# Full SAP Calculation Printout



|                                    |                        |               |       |      |                |            |
|------------------------------------|------------------------|---------------|-------|------|----------------|------------|
| Property Reference                 | 3710 3B5P              |               |       |      | Issued on Date | 22/11/2024 |
| Assessment Reference               | LZC                    | Prop Type Ref |       |      |                |            |
| Property                           | B3710 3B5P,            |               |       |      |                |            |
|                                    |                        |               |       |      |                |            |
| SAP Rating                         | 88 B                   | DER           | 1.92  | TER  | 11.56          |            |
| Environmental                      | 98 A                   | % DER < TER   |       |      |                | 83.39      |
| CO <sub>2</sub> Emissions (t/year) | 0.15                   | DFEE          | 35.96 | TFEE | 39.77          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |      |                | 9.57       |
| % DPER < TPER                      | 64.66                  | DPER          | 21.42 | TPER | 60.60          |            |
|                                    |                        |               |       |      |                |            |
| Assessor Details                   | Mr. Michael Woodbridge |               |       |      | Assessor ID    | M818-0001  |
| Client                             |                        |               |       |      |                |            |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 46.5000 (1b)              | x 2.5000 (2b)                   | = 116.2500 (1b) - (3b)      |
| First floor                                            | 46.5000 (1c)              | x 2.6000 (2c)                   | = 120.9000 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 237.1500 (5)              |

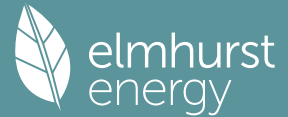
## 2. Ventilation rate

|                                                                                                         |                                                                                                                                     |             |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 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) =                                                                               |             |
| Pressure test                                                                                           | 0.0000 / (5) =                                                                                                                      | 0.0000 (8)  |
| Pressure Test Method                                                                                    | Yes                                                                                                                                 |             |
| Measured/design AP50                                                                                    | Blower Door                                                                                                                         |             |
| Infiltration rate                                                                                       | 4.0000                                                                                                                              | (17)        |
| Number of sides sheltered                                                                               | 0.2000                                                                                                                              | (18)        |
|                                                                                                         | 3                                                                                                                                   | (19)        |
| Shelter factor                                                                                          | (20) = 1 - [0.075 x (19)] =                                                                                                         | 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                                                    | (21) = (18) x (20) =                                                                                                                | 0.1550 (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                                                                                         | 0.1976 0.1938 0.1899 0.1705 0.1666 0.1473 0.1473 0.1434 0.1550 0.1666 0.1744 0.1821                                                 | (22b)       |
| Balanced mechanical ventilation with heat recovery                                                      |                                                                                                                                     |             |
| If mechanical ventilation                                                                               | 0.5000                                                                                                                              |             |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000                                                                                                                              |             |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            | 70.3800                                                                                                                             |             |
| Effective ac                                                                                            | 0.3457 0.3419 0.3380 0.3186 0.3147 0.2954 0.2954 0.2915 0.3031 0.3147 0.3225 0.3302                                                 | (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   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| W1 (Uw = 0.80)                                              |                         |                            | 2.6400                    | 0.7752                        | 2.0465       |                                | (27)            |
| W2 (Uw = 0.80)                                              |                         |                            | 1.4400                    | 0.7752                        | 1.1163       |                                | (27)            |
| W3 (Uw = 0.80)                                              |                         |                            | 1.0800                    | 0.7752                        | 0.8372       |                                | (27)            |
| W4 (Uw = 0.80)                                              |                         |                            | 2.3800                    | 0.7752                        | 1.8450       |                                | (27)            |
| W5 (Uw = 0.80)                                              |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| W6 (Uw = 0.80)                                              |                         |                            | 0.5400                    | 0.7752                        | 0.4186       |                                | (27)            |
| Front Door                                                  |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26)            |
| Rear door                                                   |                         |                            | 2.2500                    | 1.0000                        | 2.2500       |                                | (26a)           |
| Ground floor                                                |                         |                            | 46.5000                   | 0.1200                        | 5.5800       | 110.0000                       | 5115.0000 (28a) |
| External Walls                                              | 151.3170                | 13.1200                    | 138.1970                  | 0.1500                        | 20.7296      | 9.0000                         | 1243.7730 (29a) |
| Roof at ceiling                                             | 46.5000                 |                            | 46.5000                   | 0.1100                        | 5.1150       | 9.0000                         | 418.5000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 244.3170                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            | (26)...(30) + (32) =      |                               | 42.6067      |                                | (33)            |
| Internal Walls                                              |                         |                            | 197.7520                  |                               |              | 9.0000                         | 1779.7680 (32c) |

# Full SAP Calculation Printout



|                  |         |         |                |
|------------------|---------|---------|----------------|
| Internal floor   | 46.5000 | 18.0000 | 837.0000 (32d) |
| Internal ceiling | 46.5000 | 9.0000  | 418.5000 (32e) |

Heat capacity  $C_m = \text{Sum}(A \times k)$  (28)...(30) + (32) + (32a)...(32e) = 9812.5410 (34)  
Thermal mass parameter (TMP =  $C_m / \text{TFA}$ ) in kJ/m<sup>2</sup>K 105.5112 (35)

## List of Thermal Bridges

| K1 Element                                                                | Length  | Psi-value | Total   |
|---------------------------------------------------------------------------|---------|-----------|---------|
| E2 Other lintels (including other steel lintels)                          | 11.6600 | 0.0500    | 0.5830  |
| E3 Sill                                                                   | 9.5200  | 0.0400    | 0.3808  |
| E4 Jamb                                                                   | 27.9000 | 0.0500    | 1.3950  |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0700    | 0.0000  |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.1000    | 0.0000  |
| E14 Flat roof                                                             | 3.0000  | 0.0800    | 0.2400  |
| E16 Corner (normal)                                                       | 20.4000 | 0.0900    | 1.8360  |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000  | -0.0900   | -0.0000 |
| E18 Party wall between dwellings                                          | 0.0000  | 0.0600    | 0.0000  |
| E25 Staggered party wall between dwellings                                | 0.0000  | 0.1200    | 0.0000  |
| E5 Ground floor (normal)                                                  | 29.7300 | 0.1600    | 4.7568  |
| E6 Intermediate floor within a dwelling                                   | 29.7300 | 0.0700    | 2.0811  |
| E10 Eaves (insulation at ceiling level)                                   | 7.4300  | 0.0600    | 0.4458  |
| E12 Gable (insulation at ceiling level)                                   | 16.4000 | 0.2400    | 3.9360  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000  | 0.0340    | 0.0000  |
| P1 Party wall - Ground floor                                              | 0.0000  | 0.1600    | 0.0000  |
| P2 Party wall - Intermediate floor within a dwelling                      | 0.0000  | 0.0000    | 0.0000  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.6545 (36)  
Point Thermal bridges (36a) = 0.0000  
Total fabric heat loss (33) + (36) + (36a) = 58.2612 (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       | 27.0563 | 26.7530 | 26.4498 | 24.9335 | 24.6302 | 23.1139 | 23.1139 | 22.8107 | 23.7205 | 24.6302 | 25.2367 | 25.8432 (38) |
| Average = Sum(39)m / 12 = | 85.3175 | 85.0142 | 84.7110 | 83.1947 | 82.8914 | 81.3752 | 81.3752 | 81.0719 | 81.9817 | 82.8914 | 83.4980 | 84.1045 (39) |
| HLP                       | 0.9174  | 0.9141  | 0.9109  | 0.8946  | 0.8913  | 0.8750  | 0.8750  | 0.8717  | 0.8815  | 0.8913  | 0.8978  | 0.9043 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8938       |
| Days in mont              | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31           |

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

|                                                                                |          |          |          |          |          |          |          |          |          |          |              |                |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------------|-------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |              |                | 2.6646 (42) |
| Hot water usage for mixer showers                                              | 68.8963  | 67.8609  | 66.3522  | 63.4655  | 61.3351  | 58.9594  | 57.6091  | 59.1064  | 60.7477  | 63.2985  | 66.2473      | 68.6323 (42a)  |             |
| Hot water usage for baths                                                      | 29.7509  | 29.3090  | 28.6868  | 27.5396  | 26.6806  | 25.7280  | 25.2135  | 25.8314  | 26.5041  | 27.5233  | 28.6942      | 29.6503 (42b)  |             |
| Hot water usage for other uses                                                 | 41.9181  | 40.3938  | 38.8695  | 37.3453  | 35.8210  | 34.2967  | 34.2967  | 35.8210  | 37.3453  | 38.8695  | 40.3938      | 41.9181 (42c)  |             |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |              | 129.2112 (43)  |             |
| Daily hot water use                                                            | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov          | Dec            |             |
| Energy content (annual)                                                        | 140.5653 | 137.5638 | 133.9086 | 128.3503 | 123.8366 | 118.9841 | 117.1192 | 120.7587 | 124.5971 | 129.6914 | 135.3353     | 140.2008 (44)  |             |
| Distribution loss (46)m = 0.15 x (45)m                                         | 222.6211 | 195.8890 | 205.8125 | 175.7052 | 166.7079 | 146.3048 | 141.6456 | 149.5245 | 153.6407 | 175.9900 | 192.8100     | 219.5205 (45)  |             |
| 33.3932                                                                        | 29.3834  | 30.8719  | 26.3558  | 25.0062  | 21.9457  | 21.2468  | 22.4287  | 23.0461  | 26.3985  | 28.9215  | 32.9281 (46) |                |             |
| Water storage loss:                                                            |          |          |          |          |          |          |          |          |          |          |              |                |             |
| Store volume                                                                   |          |          |          |          |          |          |          |          |          |          |              | 200.0000 (47)  |             |
| a) If manufacturer declared loss factor is known (kWh/day):                    |          |          |          |          |          |          |          |          |          |          |              | 1.3200 (48)    |             |
| Temperature factor from Table 2b                                               |          |          |          |          |          |          |          |          |          |          |              | 0.6000 (49)    |             |
| Enter (49) or (54) in (55)                                                     |          |          |          |          |          |          |          |          |          |          |              | 0.7920 (55)    |             |
| Total storage loss                                                             | 24.5520  | 22.1760  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520  | 24.5520  | 23.7600  | 24.5520  | 23.7600      | 24.5520 (56)   |             |
| If cylinder contains dedicated solar storage                                   | 24.5520  | 22.1760  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520  | 24.5520  | 23.7600  | 24.5520  | 23.7600      | 24.5520 (57)   |             |
| Primary loss                                                                   | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624      | 23.2624 (59)   |             |
| 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                | 270.4355 | 239.0762 | 253.6269 | 221.9772 | 214.5223 | 192.5768 | 189.4600 | 197.3389 | 199.9127 | 223.8044 | 239.0820     | 267.3349 (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                                                                | 270.4355 | 239.0762 | 253.6269 | 221.9772 | 214.5223 | 192.5768 | 189.4600 | 197.3389 | 199.9127 | 223.8044 | 239.0820     | 267.3349 (64)  |             |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          |          |              | 2709.1478 (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                                       | 112.2730 | 99.6829  | 106.6842 | 95.4396  | 93.6819  | 85.6640  | 85.3487  | 87.9684  | 88.1031  | 96.7682  | 101.1269     | 111.2421 (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                                                                               | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 144.6496  | 160.1478  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 244.4900  | 247.0270  | 240.6338  | 227.0233  | 209.8424  | 193.6949  | 182.9074  | 180.3703  | 186.7636  | 200.3741  | 217.5549  | 233.7024 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230 (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)                                 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 (71) |
| Water heating gains (Table 5)                                                       | 150.9046  | 148.3376  | 143.3927  | 132.5550  | 125.9165  | 118.9777  | 114.7160  | 118.2371  | 122.3654  | 130.0648  | 140.4540  | 149.5189 (72)  |
| Total internal gains                                                                | 603.0131  | 618.4813  | 591.6450  | 572.0184  | 543.3775  | 525.1128  | 505.2419  | 506.2260  | 521.5692  | 538.0574  | 570.4491  | 590.8399 (73)  |



# Full SAP Calculation Printout



|                                                                            |        |        |        |        |        |        |        |        |        |        |        |           |        |
|----------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| (335b)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    | (335b) |
| Annual totals kWh/year                                                     |        |        |        |        |        |        |        |        |        |        |        |           |        |
| Space heating fuel - community heating                                     |        |        |        |        |        |        |        |        |        |        |        | 2220.0541 | (307)  |
| Space heating fuel - secondary                                             |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (309)  |
| Water heating fuel - community heating                                     |        |        |        |        |        |        |        |        |        |        |        | 2980.0626 | (310)  |
| Efficiency of water heater                                                 |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (311)  |
| Electricity used for heat distribution                                     |        |        |        |        |        |        |        |        |        |        |        | 22.2005   | (313)  |
| Space cooling fuel                                                         |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (321)  |
| Electricity for pumps and fans:                                            |        |        |        |        |        |        |        |        |        |        |        |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250) |        |        |        |        |        |        |        |        |        |        |        |           |        |
| mechanical ventilation fans (SFP = 0.6250)                                 |        |        |        |        |        |        |        |        |        |        |        | 180.8269  | (330a) |
| Total electricity for the above, kWh/year                                  |        |        |        |        |        |        |        |        |        |        |        | 180.8269  | (331)  |
| Electricity for lighting (calculated in Appendix L)                        |        |        |        |        |        |        |        |        |        |        |        | 290.5204  | (332)  |
| Energy saving/generation technologies (Appendices M ,N and Q)              |        |        |        |        |        |        |        |        |        |        |        |           |        |
| PV generation                                                              |        |        |        |        |        |        |        |        |        |        |        | -863.6197 | (333)  |
| Wind generation                                                            |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (334)  |
| Hydro-electric generation (Appendix N)                                     |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (335a) |
| Electricity generated - Micro CHP (Appendix N)                             |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (335)  |
| Appendix Q - special features                                              |        |        |        |        |        |        |        |        |        |        |        |           |        |
| Energy saved or generated                                                  |        |        |        |        |        |        |        |        |        |        |        | -0.0000   | (336)  |
| Energy used                                                                |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (337)  |
| Total delivered energy for all uses                                        |        |        |        |        |        |        |        |        |        |        |        | 4807.8443 | (338)  |

## 12b. Carbon dioxide emissions - Community heating scheme

|                                                         | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |       |
|---------------------------------------------------------|--------------------|-------------------------------|--------------------------|-------|
| Efficiency of heat source Heat pump                     |                    |                               | 354.0000                 | (367) |
| Space and Water heating from Heat pump                  | 1468.9595          | 0.1554                        | 97.4517                  | (367) |
| Electrical energy for heat distribution (space & water) | 22.2005            | 0.0000                        | 7.6512                   | (372) |
| Overall CO2 factor for heat network                     |                    |                               | 0.0430                   | (386) |
| Total CO2 associated with community systems             |                    |                               | 223.7856                 | (373) |
| Space and water heating                                 |                    |                               | 223.7856                 | (376) |
| Pumps, fans and electric keep-hot                       | 180.8269           | 0.1387                        | 25.0829                  | (378) |
| Energy for lighting                                     | 290.5204           | 0.1443                        | 41.9311                  | (379) |
| Energy saving/generation technologies                   |                    |                               |                          |       |
| PV Unit electricity used in dwelling                    | -662.1564          | 0.1325                        | -87.7201                 |       |
| PV Unit electricity exported                            | -201.4633          | 0.1218                        | -24.5375                 |       |
| Total                                                   |                    |                               | -112.2576                | (380) |
| Total CO2, kg/year                                      |                    |                               | 178.5421                 | (383) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER)         |                    |                               | 1.9200                   | (384) |

## 13b. Primary energy - Community heating scheme

|                                                         | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |        |
|---------------------------------------------------------|--------------------|-------------------------------------|----------------------------|--------|
| Efficiency of heat source Heat pump                     |                    |                                     | 354.0000                   | (467a) |
| Space and Water heating from Heat pump                  | 1468.9595          | 1.5753                              | 987.9178                   | (467)  |
| Electrical energy for heat distribution (space & water) | 22.2005            | 0.0000                              | 80.3082                    | (472)  |
| Overall CO2 factor for heat network                     |                    |                                     | 0.4517                     | (486)  |
| Total CO2 associated with community systems             |                    |                                     | 2348.9009                  | (473)  |
| Space and water heating                                 |                    |                                     | 2348.9009                  | (476)  |
| Pumps, fans and electric keep-hot                       | 180.8269           | 1.5128                              | 273.5549                   | (478)  |
| Energy for lighting                                     | 290.5204           | 1.5338                              | 445.6100                   | (479)  |
| Energy saving/generation technologies                   |                    |                                     |                            |        |
| PV Unit electricity used in dwelling                    | -662.1564          | 1.4895                              | -986.2757                  |        |
| PV Unit electricity exported                            | -201.4633          | 0.4469                              | -90.0289                   |        |
| Total                                                   |                    |                                     | -1076.3046                 | (480)  |
| Total Primary energy kWh/year                           |                    |                                     | 1991.7612                  | (483)  |
| Dwelling Primary energy Rate (DPER)                     |                    |                                     | 21.4200                    | (484)  |

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

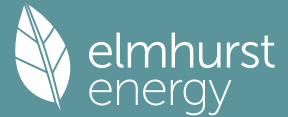
### 1. Overall dwelling characteristics

|                                                        | Area<br>(m2) | Storey height<br>(m)            | Volume<br>(m3)         |  |
|--------------------------------------------------------|--------------|---------------------------------|------------------------|--|
| Ground floor                                           | 46.5000 (1b) | x 2.5000 (2b)                   | = 116.2500 (1b) - (3b) |  |
| First floor                                            | 46.5000 (1c) | x 2.6000 (2c)                   | = 120.9000 (1c) - (3c) |  |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.0000      |                                 | (4)                    |  |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 237.1500 (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)  |

# Full SAP Calculation Printout



Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 30.0000 / (5) = 0.1265 (8)  
Pressure test Yes  
Pressure Test Method Blower Door  
Measured/design AP50 5.0000 (17)  
Infiltration rate 0.3765 (18)  
Number of sides sheltered 3 (19)  
Shelter factor (20) = 1 - [0.075 x (19)] = 0.7750 (20)  
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2918 (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 |        |        |        |        |        |        |        |        |        |        |        |        |       |
|                 | 0.3720 | 0.3647 | 0.3574 | 0.3210 | 0.3137 | 0.2772 | 0.2772 | 0.2699 | 0.2918 | 0.3137 | 0.3283 | 0.3429 | (22b) |
| Effective ac    | 0.5692 | 0.5665 | 0.5639 | 0.5515 | 0.5492 | 0.5384 | 0.5384 | 0.5364 | 0.5426 | 0.5492 | 0.5539 | 0.5588 | (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                                |             |                | 2.2500        | 1.0000           | 2.2500               |                   |               | (26)  |
| TER Semi-glazed door                           |             |                | 2.2500        | 1.0000           | 2.2500               |                   |               | (26a) |
| TER Opening Type (Uw = 1.20)                   |             |                | 8.6200        | 1.1450           | 9.8702               |                   |               | (27)  |
| Ground floor                                   |             |                | 46.5000       | 0.1300           | 6.0450               |                   |               | (28a) |
| External Walls                                 | 151.3170    | 13.1200        | 138.1970      | 0.1800           | 24.8755              |                   |               | (29a) |
| Roof at ceiling                                | 46.5000     |                | 46.5000       | 0.1100           | 5.1150               |                   |               | (30)  |
| Total net area of external elements Aum(A, m2) |             |                | 244.3170      |                  |                      |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               |                  | 50.4057              |                   |               | (33)  |
|                                                |             |                |               |                  | (26)...(30) + (32) = |                   |               |       |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 105.5112 (35)

#### List of Thermal Bridges

| K1 Element                                                                | Length  | Psi-value | Total   |  |
|---------------------------------------------------------------------------|---------|-----------|---------|--|
| E2 Other lintels (including other steel lintels)                          | 11.6600 | 0.0500    | 0.5830  |  |
| E3 Sill                                                                   | 9.5200  | 0.0500    | 0.4760  |  |
| E4 Jamb                                                                   | 27.9000 | 0.0500    | 1.3950  |  |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0700    | 0.0000  |  |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.0000    | 0.0000  |  |
| E14 Flat roof                                                             | 3.0000  | 0.0800    | 0.2400  |  |
| E16 Corner (normal)                                                       | 20.4000 | 0.0900    | 1.8360  |  |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000  | -0.0900   | -0.0000 |  |
| E18 Party wall between dwellings                                          | 0.0000  | 0.0600    | 0.0000  |  |
| E25 Staggered party wall between dwellings                                | 0.0000  | 0.0600    | 0.0000  |  |
| E5 Ground floor (normal)                                                  | 29.7300 | 0.1600    | 4.7568  |  |
| E6 Intermediate floor within a dwelling                                   | 29.7300 | 0.0000    | 0.0000  |  |
| E10 Eaves (insulation at ceiling level)                                   | 7.4300  | 0.0600    | 0.4458  |  |
| E12 Gable (insulation at ceiling level)                                   | 16.4000 | 0.0600    | 0.9840  |  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000  |  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000  | 0.1200    | 0.0000  |  |
| P1 Party wall - Ground floor                                              | 0.0000  | 0.0800    | 0.0000  |  |
| P2 Party wall - Intermediate floor within a dwelling                      | 0.0000  | 0.0000    | 0.0000  |  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.7166 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 61.1223 (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      |      |
|                           | 44.5456  | 44.3353  | 44.1291  | 43.1609  | 42.9798  | 42.1365  | 42.1365  | 41.9803  | 42.4613  | 42.9798  | 43.3462  | 43.7294  | (38) |
| Heat transfer coeff       | 105.6679 | 105.4576 | 105.2514 | 104.2832 | 104.1021 | 103.2588 | 103.2588 | 103.1026 | 103.5836 | 104.1021 | 104.4685 | 104.8517 | (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 104.2823 |      |

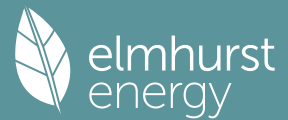
|               |        |        |        |        |        |        |        |        |        |        |        |        |      |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
|               | 1.1362 | 1.1340 | 1.1317 | 1.1213 | 1.1194 | 1.1103 | 1.1103 | 1.1086 | 1.1138 | 1.1194 | 1.1233 | 1.1274 | (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1213 |      |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |      |

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

|                                          |         |         |         |         |         |         |         |         |         |         |         |         |               |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------|
| Assumed occupancy                        |         |         |         |         |         |         |         |         |         |         |         |         | 2.6646 (42)   |
| Hot water usage for mixer showers        |         |         |         |         |         |         |         |         |         |         |         |         |               |
|                                          | 68.8963 | 67.8609 | 66.3522 | 63.4655 | 61.3351 | 58.9594 | 57.6091 | 59.1064 | 60.7477 | 63.2985 | 66.2473 | 68.6323 | (42a)         |
| Hot water usage for baths                |         |         |         |         |         |         |         |         |         |         |         |         |               |
|                                          | 29.7509 | 29.3090 | 28.6868 | 27.5396 | 26.6806 | 25.7280 | 25.2135 | 25.8314 | 26.5041 | 27.5233 | 28.6942 | 29.6503 | (42b)         |
| Hot water usage for other uses           |         |         |         |         |         |         |         |         |         |         |         |         |               |
|                                          | 41.9181 | 40.3938 | 38.8695 | 37.3453 | 35.8210 | 34.2967 | 34.2967 | 35.8210 | 37.3453 | 38.8695 | 40.3938 | 41.9181 | (42c)         |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |         |         | 129.2112 (43) |

|                                                                 |          |          |          |          |          |          |          |          |          |                    |          |           |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------|-----------|---------------|
| Daily hot water use                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec       |               |
|                                                                 | 140.5653 | 137.5638 | 133.9086 | 128.3503 | 123.8366 | 118.9841 | 117.1192 | 120.7587 | 124.5971 | 129.6914           | 135.3353 | 140.2008  | (44)          |
| Energy conte                                                    | 222.6211 | 195.8890 | 205.8125 | 175.7052 | 166.7079 | 146.3048 | 141.6456 | 149.5245 | 153.6407 | 175.9900           | 192.8100 | 219.5205  | (45)          |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 2146.1718 |               |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |                    |          |           |               |
|                                                                 | 33.3932  | 29.3834  | 30.8719  | 26.3558  | 25.0062  | 21.9457  | 21.2468  | 22.4287  | 23.0461  | 26.3985            | 28.9215  | 32.9281   | (46)          |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                    |          |           |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                    |          |           | 200.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                    |          |           | 1.6525 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                    |          |           | 0.5400 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                    |          |           | 0.8924 (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 |          |          |          |          |          |          |          |          |          |                    |          |           |               |
|                                                                 | 273.5472 | 241.8868 | 256.7385 | 224.9885 | 217.6340 | 195.5881 | 192.5716 | 200.4506 | 202.9240 | 226.9161           | 242.0933 | 270.4466  | (62)          |
| WWHRS                                                           | -31.4965 | -27.8558 | -29.1690 | -24.1531 | -22.5098 | -19.2618 | -18.0548 | -19.1995 | -19.9290 | -23.4941           | -26.6159 | -30.9132  | (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)         |

# Full SAP Calculation Printout



|                                          |                                                                                |          |          |          |          |          |          |          |          |          |          |                |
|------------------------------------------|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| 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                          | 242.0507                                                                       | 214.0310 | 227.5696 | 200.8354 | 195.1242 | 176.3264 | 174.5168 | 181.2511 | 182.9950 | 203.4221 | 215.4773 | 239.5334 (64)  |
|                                          | Total per year (kWh/year) = Sum(64)m =                                         |          |          |          |          |          |          |          |          |          |          | 2453.1328 (64) |
| 12Total per year (kWh/year)              |                                                                                |          |          |          |          |          |          |          |          |          |          | 2453 (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 | 114.7624                                                                       | 101.9313 | 109.1735 | 97.8486  | 96.1712  | 88.0730  | 87.8380  | 90.4578  | 90.5122  | 99.2575  | 103.5359 | 113.7314 (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                                                                               | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | 133.2299  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 144.6496  | 160.1478  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496  | 144.6496  | 149.4712  | 144.6496  | 149.4712  | 144.6496  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 244.4900  | 247.0270  | 240.6338  | 227.0233  | 209.8424  | 193.6949  | 182.9074  | 180.3703  | 186.7636  | 200.3741  | 217.5549  | 233.7024  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | 36.3230   | (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    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | -106.5839 | (71) |
| Water heating gains (Table 5)                                                       | 154.2505  | 151.6835  | 146.7386  | 135.9008  | 129.2624  | 122.3236  | 118.0618  | 121.5830  | 125.7113  | 133.4107  | 143.7999  | 152.8648  | (72) |
| Total internal gains                                                                | 609.3590  | 624.8272  | 597.9909  | 578.3643  | 549.7234  | 528.4587  | 508.5877  | 509.5719  | 524.9151  | 544.4033  | 576.7950  | 597.1858  | (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   |          |          |          |               |
|-------------|--|--|--|--|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|--------------|----------|----------|----------|---------------|
| <hr/>       |  |  |  |  |            |                                |                                   |                                    |                              |          |          |              |          |          |          |               |
| Northeast   |  |  |  |  | 3.4600     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 11.9308 (75) |          |          |          |               |
| Southeast   |  |  |  |  | 0.5400     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 6.0721 (77)  |          |          |          |               |
| Southwest   |  |  |  |  | 4.0800     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 45.8783 (79) |          |          |          |               |
| Northwest   |  |  |  |  | 0.5400     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          |          | 1.8620 (81)  |          |          |          |               |
| <hr/>       |  |  |  |  |            |                                |                                   |                                    |                              |          |          |              |          |          |          |               |
| Solar gains |  |  |  |  | 65.7432    | 116.5665                       | 171.6605                          | 233.0929                           | 279.7011                     | 285.8678 | 272.1990 | 236.1752     | 192.7375 | 132.1119 | 79.5796  | 55.7226 (83)  |
| Total gains |  |  |  |  | 675.1023   | 741.3937                       | 769.6513                          | 811.4572                           | 829.4246                     | 814.3265 | 780.7868 | 745.7471     | 717.6527 | 676.5152 | 656.3746 | 652.9084 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                                       |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                                       |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                                       |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                                   | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 25.7950                               | 25.8465 | 25.8971 | 26.1375 | 26.1830 | 26.3968 | 26.3968 | 26.4368 | 26.3141 | 26.1830 | 26.0912 | 25.9958      |
| alpha                                                                       | 2.7197                                | 2.7231  | 2.7265  | 2.7425  | 2.7455  | 2.7598  | 2.7598  | 2.7625  | 2.7543  | 2.7455  | 2.7394  | 2.7331       |
| util living area                                                            | 0.9534                                | 0.9382  | 0.9168  | 0.8684  | 0.7869  | 0.6535  | 0.5191  | 0.5549  | 0.7321  | 0.8754  | 0.9344  | 0.9572 (86)  |
| MIT                                                                         | 18.6098                               | 18.8612 | 19.2479 | 19.8061 | 20.3234 | 20.7232 | 20.8945 | 20.8699 | 20.5933 | 19.9484 | 19.2037 | 18.5694 (87) |
| Th 2                                                                        | 19.9714                               | 19.9732 | 19.9750 | 19.9835 | 19.9850 | 19.9924 | 19.9924 | 19.9938 | 19.9896 | 19.9850 | 19.9818 | 19.9785 (88) |
| util rest of house                                                          | 0.9465                                | 0.9290  | 0.9037  | 0.8461  | 0.7472  | 0.5842  | 0.4202  | 0.4578  | 0.6716  | 0.8500  | 0.9231  | 0.9508 (89)  |
| MIT 2                                                                       | 17.1889                               | 17.5066 | 17.9947 | 18.6932 | 19.3170 | 19.7686 | 19.9310 | 19.9134 | 19.6365 | 18.8790 | 17.9487 | 17.1421 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = 0.1892 (91) |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 17.4578                               | 17.7630 | 18.2319 | 18.9038 | 19.5075 | 19.9493 | 20.1134 | 20.0944 | 19.8176 | 19.0814 | 18.1862 | 17.4122 (92) |
| Temperature adjustment                                                      | 0.0000                                |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 17.4578                               | 17.7630 | 18.2319 | 18.9038 | 19.5075 | 19.9493 | 20.1134 | 20.0944 | 19.8176 | 19.0814 | 18.1862 | 17.4122 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |          |           |              |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|--------------|-------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec          |       |
|                                                                                | 0.9226    | 0.9022    | 0.8747    | 0.8170    | 0.7255   | 0.5809   | 0.4329   | 0.4683   | 0.6599   | 0.8217   | 0.8961    | 0.9280       | (94)  |
| Useful gains                                                                   | 622.8620  | 668.8617  | 673.1822  | 662.9522  | 601.7816 | 473.0561 | 337.9759 | 349.2508 | 473.5578 | 555.8915 | 588.1967  | 605.8984     | (95)  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000    | 8.0000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000       | (96)  |
| Heat loss rate W                                                               | 1390.3555 | 1356.4964 | 1234.7960 | 1043.2271 | 812.7767 | 552.3569 | 362.7878 | 380.9069 | 592.2451 | 882.9298 | 1158.1629 | 1385.3207    | (97)  |
| Space heating kWh                                                              | 571.0152  | 462.0905  | 417.8407  | 273.7980  | 156.9804 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.3165 | 410.3756  | 579.8902     | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |          |           | 3115.3071    |       |
| 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                                                              | 571.0152  | 462.0905  | 417.8407  | 273.7980  | 156.9804 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.3165 | 410.3756  | 579.8902     | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |          |           | 3115.3071    |       |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          |          |           | 33.4979 (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 %)                      |          |          |          |          |          |        |        |        |        |          |          | 92.3000 (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                                             | 571.0152 | 462.0905 | 417.8407 | 273.7980 | 156.9804 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 243.3165 | 410.3756 | 579.8902 (98) |

# Full SAP Calculation Printout



|                                                                                                      |          |          |           |           |           |           |           |           |           |          |          |            |        |
|------------------------------------------------------------------------------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------|--------|
| 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)                                                             | 618.6513 | 500.6398 | 452.6985  | 296.6392  | 170.0763  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 263.6149 | 444.6106 | 628.2668   | (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                                                                            | 242.0507 | 214.0310 | 227.5696  | 200.8354  | 195.1242  | 176.3264  | 174.5168  | 181.2511  | 182.9950  | 203.4221 | 215.4773 | 239.5334   | (64)   |
| Efficiency of water heater                                                                           | 85.9154  | 85.7390  | 85.4038   | 84.7553   | 83.5765   | 79.8000   | 79.8000   | 79.8000   | 79.8000   | 84.4624  | 85.4808  | 85.9658    | (216)  |
| Fuel for water heating, kWh/month                                                                    | 281.7315 | 249.6310 | 266.4631  | 236.9592  | 233.4679  | 220.9603  | 218.6927  | 227.1317  | 229.3170  | 240.8433 | 252.0770 | 278.6378   | (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                                                                                         | 7.3041   | 6.5973   | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685   | 7.3041   | 7.0685     | (231)  |
| Lighting                                                                                             | 30.0553  | 24.1115  | 21.7097   | 15.9055   | 12.2858   | 10.0376   | 11.2076   | 14.5680   | 18.9224   | 24.8272  | 28.0423  | 30.8907    | (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -42.9488 | -60.2409 | -86.1180  | -96.2428  | -103.2470 | -96.1468  | -94.9618  | -89.9398  | -80.9511  | -68.6474 | -47.1123 | -37.1684   | (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)                                        | -25.1363 | -52.8027 | -104.8291 | -157.2766 | -207.8075 | -208.7691 | -206.3065 | -174.7280 | -128.1401 | -75.4410 | -33.5352 | -19.8815   | (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                                                                   |          |          |           |           |           |           |           |           |           |          |          | 3375.1973  | (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                                                                              |          |          |           |           |           |           |           |           |           |          |          | 2935.9125  | (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)                                                  |          |          |           |           |           |           |           |           |           |          |          | 242.5637   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |           |           |           |           |           |           |           |          |          |            |        |
| PV generation                                                                                        |          |          |           |           |           |           |           |           |           |          |          | -2298.3790 | (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                                                                  |          |          |           |           |           |           |           |           |           |          |          | 4341.2944  | (238)  |

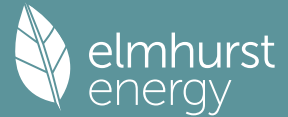
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 3375.1973          | 0.2100                        | 708.7914 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2935.9125          | 0.2100                        | 616.5416 (264)           |
| Space and water heating                       |                    |                               | 1325.3330 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 242.5637           | 0.1443                        | 35.0094 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -903.7252          | 0.1347                        | -121.7427                |
| PV Unit electricity exported                  | -1394.6538         | 0.1259                        | -175.6246                |
| Total                                         |                    |                               | -297.3674 (269)          |
| Total CO2, kg/year                            |                    |                               | 1074.9044 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 11.5600 (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               | 3375.1973          | 1.1300                              | 3813.9729 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2935.9125          | 1.1300                              | 3317.5811 (278)            |
| Space and water heating                     |                    |                                     | 7131.5540 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 242.5637           | 1.5338                              | 372.0523 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -903.7252          | 1.4979                              | -1353.6722                 |
| PV Unit electricity exported                | -1394.6538         | 0.4622                              | -644.6649                  |
| Total                                       |                    |                                     | -1998.3371 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 5635.3700 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 60.6000 (287)              |

# Full SAP Calculation Printout



|                                    |                        |  |               |               |                |             |           |
|------------------------------------|------------------------|--|---------------|---------------|----------------|-------------|-----------|
| Property Reference                 | 4029 4B8P det          |  |               |               | Issued on Date | 22/11/2024  |           |
| Assessment Reference               | Fabric                 |  |               | Prop Type Ref |                |             |           |
| Property                           | 4029 4B8P det,         |  |               |               |                |             |           |
|                                    |                        |  |               |               |                |             |           |
| SAP Rating                         | 85 B                   |  | DER           | 8.48          |                | TER         | 9.59      |
| Environmental                      | 92 A                   |  | % DER < TER   |               |                |             | 11.57     |
| CO <sub>2</sub> Emissions (t/year) | 1.08                   |  | DFEE          | 33.20         |                | TFEE        | 38.33     |
| Compliance Check                   | See BREL               |  | % DFEE < TFEE |               |                |             | 13.39     |
| % DPER < TPER                      | -5.91                  |  | DPER          | 53.16         |                | TPER        | 50.20     |
|                                    |                        |  |               |               |                |             |           |
| Assessor Details                   | Mr. Michael Woodbridge |  |               |               |                | Assessor ID | M818-0001 |
| Client                             |                        |  |               |               |                |             |           |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 64.8000 (1b)              | x 2.5000 (2b)                   | = 162.0000 (1b) - (3b)      |
| First floor                                            | 76.6900 (1c)              | x 2.5000 (2c)                   | = 191.7250 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.4900                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 353.7250 (5)              |

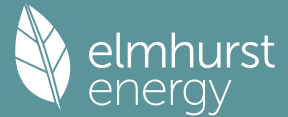
## 2. Ventilation rate

|                                                                                                         | 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                                                                                    | 4.0000 (17)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate                                                                                       | 0.2000 (18)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Number of sides sheltered                                                                               | 3 (19)                                                                          |            |            |            |            |            |            |            |            |            |            |                 |
| Shelter factor                                                                                          | (20) = 1 - [0.075 x (19)] = 0.7750 (20)                                         |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate adjusted to include shelter factor                                                    | (21) = (18) x (20) = 0.1550 (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                                                                                         | 0.1976                                                                          | 0.1938     | 0.1899     | 0.1705     | 0.1666     | 0.1473     | 0.1473     | 0.1434     | 0.1550     | 0.1666     | 0.1744     | 0.1821 (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) =            |                                                                                 |            |            |            |            |            |            |            |            |            |            | 70.3800 (23c)   |
| Effective ac                                                                                            | 0.3457                                                                          | 0.3419     | 0.3380     | 0.3186     | 0.3147     | 0.2954     | 0.2954     | 0.2915     | 0.3031     | 0.3147     | 0.3225     | 0.3302 (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   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| W1 (Uw = 0.80)                                              |                         |                            | 2.1600                    | 0.7752                        | 1.6744       |                                | (27)            |
| W2 (Uw = 0.80)                                              |                         |                            | 5.6700                    | 0.7752                        | 4.3953       |                                | (27)            |
| W3 (Uw = 0.80)                                              |                         |                            | 0.9500                    | 0.7752                        | 0.7364       |                                | (27)            |
| W4 (Uw = 0.80)                                              |                         |                            | 1.4400                    | 0.7752                        | 1.1163       |                                | (27)            |
| W5 (Uw = 0.80)                                              |                         |                            | 5.6700                    | 0.7752                        | 4.3953       |                                | (27)            |
| W6 (Uw = 0.80)                                              |                         |                            | 0.9500                    | 0.7752                        | 0.7364       |                                | (27)            |
| Front Door                                                  |                         |                            | 3.3800                    | 1.0000                        | 3.3800       |                                | (26a)           |
| Ground floor                                                |                         |                            | 64.8000                   | 0.1200                        | 7.7760       | 110.0000                       | 7128.0000 (28a) |
| Exposed over garage                                         |                         |                            | 14.9000                   | 0.1200                        | 1.7880       | 20.0000                        | 298.0000 (28b)  |
| External Walls                                              | 154.0520                | 20.2200                    | 133.8320                  | 0.1500                        | 20.0748      | 9.0000                         | 1204.4880 (29a) |
| Wall to garage                                              | 16.3540                 |                            | 16.3540                   | 0.1400                        | 2.2896       | 60.0000                        | 981.2400 (29a)  |
| Roof at ceiling                                             | 64.9000                 |                            | 64.9000                   | 0.1100                        | 7.1390       | 9.0000                         | 584.1000 (30)   |
| Roof at slope                                               | 17.8800                 |                            | 17.8800                   | 0.1800                        | 3.2184       | 9.0000                         | 160.9200 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 332.8860                  |                               |              |                                | (31)            |

# Full SAP Calculation Printout



|                                     |                      |         |                 |
|-------------------------------------|----------------------|---------|-----------------|
| Fabric heat loss, W/K = Sum (A x U) | (26)...(30) + (32) = | 58.7200 | (33)            |
| Internal Walls                      | 237.6600             | 9.0000  | 2138.9400 (32c) |
| Internal floor                      | 53.4700              | 18.0000 | 962.4600 (32d)  |
| Internal ceiling                    | 53.4700              | 9.0000  | 481.2300 (32e)  |

|                                                   |                                      |            |      |
|---------------------------------------------------|--------------------------------------|------------|------|
| Heat capacity Cm = Sum(A x k)                     | (28)...(30) + (32) + (32a)...(32e) = | 13939.3781 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K |                                      | 98.5185    | (35) |

|                                                                           |                       |           |                |
|---------------------------------------------------------------------------|-----------------------|-----------|----------------|
| List of Thermal Bridges                                                   | Length                | Psi-value | Total          |
| K1 Element                                                                | 18.3000               | 0.3000    | 5.4900         |
| E2 Other lintels (including other steel lintels)                          | 16.9500               | 0.0400    | 0.6780         |
| E3 Sill                                                                   | 34.4000               | 0.0500    | 1.7200         |
| E4 Jamb                                                                   | 0.0000                | 0.0700    | 0.0000         |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000                | 0.1000    | 0.0000         |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000                | 0.1600    | 0.0000         |
| E14 Flat roof                                                             | 22.9000               | 0.0900    | 2.0610         |
| E16 Corner (normal)                                                       | 2.5000                | -0.0900   | -0.2250        |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000                | 0.0600    | 0.0000         |
| E18 Party wall between dwellings                                          | 0.0000                | 0.2400    | 0.0000         |
| E25 Staggered party wall between dwellings                                | 29.8700               | 0.0510    | 1.5234         |
| E5 Ground floor (normal)                                                  | 29.8700               | 0.0110    | 0.3286         |
| E6 Intermediate floor within a dwelling                                   | 16.4300               | 0.0200    | 0.3286         |
| E10 Baves (insulation at ceiling level)                                   | 18.4800               | 0.2400    | 4.4352         |
| E12 Gable (insulation at ceiling level)                                   | 19.9300               | 0.3200    | 6.3776         |
| E21 Exposed floor (inverted)                                              | 0.0000                | 0.0000    | 0.0000         |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000                | 0.0340    | 0.0000         |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000                | 0.3200    | 0.0000         |
| P1 Party wall - Ground floor                                              | 0.0000                | 0.0000    | 0.0000         |
| P2 Party wall - Intermediate floor within a dwelling                      |                       |           |                |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |                       |           | 22.7173 (36)   |
| Point Thermal bridges                                                     |                       |           | (36a) = 0.0000 |
| Total fabric heat loss                                                    | (33) + (36) + (36a) = |           | 81.4374 (37)   |

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (38)m                                                               | 40.3562  | 39.9039  | 39.4516  | 37.1899  | 36.7376  | 34.4760  | 34.4760  | 34.0237  | 35.3806  | 36.7376  | 37.6423  | 38.5469  | (38) |
| Heat transfer coeff                                                 | 121.7936 | 121.3413 | 120.8889 | 118.6273 | 118.1750 | 115.9134 | 115.9134 | 115.4610 | 116.8180 | 118.1750 | 119.0796 | 119.9843 | (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 118.5142 |      |
|                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| HLP                                                                 | 0.8608   | 0.8576   | 0.8544   | 0.8384   | 0.8352   | 0.8192   | 0.8192   | 0.8160   | 0.8256   | 0.8352   | 0.8416   | 0.8480   | (40) |
| HLP (average)                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.8376   |      |
| Days in month                                                       | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

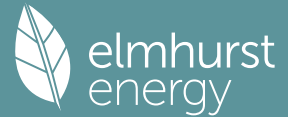
## 4. Water heating energy requirements (kWh/year)

|                                                                                |          |          |          |          |          |         |         |                                        |         |                    |          |           |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------------------------------------|---------|--------------------|----------|-----------|-------------|
| Assumed occupancy                                                              |          |          |          |          |          |         |         |                                        |         |                    |          |           | 2.9199 (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                                                      | 31.5915  | 31.1223  | 30.4616  | 29.2434  | 28.3312  | 27.3197 | 26.7734 | 27.4295                                | 28.1438 | 29.2261            | 30.4694  | 31.4847   | (42b)       |
| Hot water usage for other uses                                                 | 44.5324  | 42.9130  | 41.2936  | 39.6743  | 38.0549  | 36.4356 | 36.4356 | 38.0549                                | 39.6743 | 41.2936            | 42.9130  | 44.5324   | (42c)       |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |         |         |                                        |         |                    |          | 69.7742   | (43)        |
| Daily hot water use                                                            | 76.1238  | 74.0353  | 71.7552  | 68.9177  | 66.3861  | 63.7553 | 63.2090 | 65.4844                                | 67.8181 | 70.5198            | 73.3824  | 76.0170   | (44)        |
| Energy conte                                                                   | 120.5616 | 105.4253 | 110.2851 | 94.3449  | 89.3685  | 78.3946 | 76.4458 | 81.0834                                | 83.6265 | 95.6947            | 104.5467 | 119.0243  | (45)        |
| Energy content (annual)                                                        |          |          |          |          |          |         |         |                                        |         | Total = Sum(45)m = |          | 1158.8013 |             |
| Distribution loss (46)m = 0.15 x (45)m                                         | 18.0842  | 15.8138  | 16.5428  | 14.1517  | 13.4053  | 11.7592 | 11.4669 | 12.1625                                | 12.5440 | 14.3542            | 15.6820  | 17.8536   | (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                                   |          |          |          |          |          |         |         |                                        |         |                    |          |           |             |
| Primary loss                                                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000                                 | 0.0000  | 0.0000             | 0.0000   | 0.0000    | (57)        |
| Combi loss                                                                     | 13.9768  | 12.6126  | 13.9465  | 13.4688  | 13.8989  | 13.4328 | 13.8725 | 13.8840                                | 13.4489 | 13.9185            | 13.4969  | 13.9737   | (61)        |
| Total heat required for water heating calculated for each month                | 134.5384 | 118.0379 | 124.2316 | 107.8137 | 103.2674 | 91.8273 | 90.3183 | 94.9674                                | 97.0754 | 109.6132           | 118.0437 | 132.9980  | (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                                                                | 134.5384 | 118.0379 | 124.2316 | 107.8137 | 103.2674 | 91.8273 | 90.3183 | 94.9674                                | 97.0754 | 109.6132           | 118.0437 | 132.9980  | (64)        |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |         |         | Total per year (kWh/year) = Sum(64)m = |         |                    |          | 1322.7323 | (64)        |
| Electric shower(s)                                                             | 58.6021  | 52.2150  | 57.0167  | 54.4104  | 55.4314  | 52.8762 | 54.6387 | 55.4314                                | 54.4104 | 57.0167            | 55.9446  | 58.6021   | (64a)       |
| Heat gains from water heating, kWh/month                                       | 58.2315  | 51.2608  | 54.4106  | 48.3395  | 47.0476  | 42.6434 | 42.5460 | 44.2891                                | 44.7706 | 49.5523            | 52.1222  | 57.7195   | (65)        |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |         |         |                                        |         |                    |          | 666.5957  | (64a)       |

## 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                                                                               | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 174.4857  | 193.1806  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.0999  | 314.3281  | 306.1930  | 288.8744  | 267.0128  | 246.4660  | 232.7394  | 229.5112  | 237.6462  | 254.9648  | 276.8265  | 297.3733  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | (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    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | (71) |
| Water heating gains (Table 5)                                                       | 78.2681   | 76.2810   | 73.1326   | 67.1382   | 63.2360   | 59.2270   | 57.1855   | 59.5283   | 62.1814   | 66.6025   | 72.3919   | 77.5800   | (72) |
| Total internal gains                                                                | 633.6517  | 653.5877  | 623.6093  | 606.1125  | 574.5326  | 552.7929  | 531.2087  | 530.3232  | 546.9276  | 565.8511  | 599.3183  | 619.2371  | (73) |

# Full SAP Calculation Printout



## 6. Solar gains

| [Jan]       |          |           |           |           | Area<br>m <sup>2</sup> | Solar flux<br>Table 6a<br>W/m <sup>2</sup> | Specific data<br>or Table 6b | g         | Specific data<br>or Table 6c | FF        | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|-----------|-----------|-----------|------------------------|--------------------------------------------|------------------------------|-----------|------------------------------|-----------|------------------------------|---------------|
| North       |          |           |           |           | 2.1600                 | 10.6334                                    |                              | 0.6300    |                              | 0.0000    | 0.7700                       | 11.1418 (74)  |
| South       |          |           |           |           | 5.6700                 | 46.7521                                    |                              | 0.6300    |                              | 0.0000    | 0.7700                       | 128.5923 (78) |
| South       |          |           |           |           | 0.9500                 | 46.7521                                    |                              | 0.6300    |                              | 0.0000    | 0.7700                       | 21.5455 (78)  |
| South       |          |           |           |           | 1.4400                 | 46.7521                                    |                              | 0.6300    |                              | 0.0000    | 0.7700                       | 32.6584 (78)  |
| East        |          |           |           |           | 5.6700                 | 19.6403                                    |                              | 0.6300    |                              | 0.0000    | 0.7700                       | 54.0209 (76)  |
| East        |          |           |           |           | 0.9500                 | 19.6403                                    |                              | 0.6300    |                              | 0.0000    | 0.7700                       | 9.0511 (76)   |
| Solar gains | 257.0100 | 444.0479  | 620.7224  | 785.4675  | 890.6051               | 887.8224                                   | 854.5144                     | 776.2454  | 678.1867                     | 494.6514  | 309.0641                     | 219.1085 (83) |
| Total gains | 890.6617 | 1097.6356 | 1244.3318 | 1391.5800 | 1465.1377              | 1440.6153                                  | 1385.7231                    | 1306.5687 | 1225.1143                    | 1060.5025 | 908.3824                     | 838.3455 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 31.7919                   | 31.9104 | 32.0298 | 32.6405 | 32.7654 | 33.4047 | 33.4047 | 33.5356 | 33.1460 | 32.7654 | 32.5165 | 32.2713      |
| alpha                                                                       | 3.1195                    | 3.1274  | 3.1353  | 3.1760  | 3.1844  | 3.2270  | 3.2270  | 3.2357  | 3.2097  | 3.1844  | 3.1678  | 3.1514       |
| util living area                                                            | 0.9558                    | 0.9204  | 0.8692  | 0.7722  | 0.6429  | 0.4837  | 0.3587  | 0.3931  | 0.5871  | 0.8138  | 0.9265  | 0.9622 (86)  |
| MIT                                                                         | 19.0867                   | 19.4720 | 19.9113 | 20.4111 | 20.7433 | 20.9260 | 20.9786 | 20.9712 | 20.8576 | 20.4020 | 19.6740 | 19.0342 (87) |
| Th 2                                                                        | 20.2010                   | 20.2037 | 20.2064 | 20.2202 | 20.2229 | 20.2367 | 20.2367 | 20.2395 | 20.2312 | 20.2229 | 20.2174 | 20.2119 (88) |
| util rest of house                                                          | 0.9501                    | 0.9108  | 0.8538  | 0.7468  | 0.6051  | 0.4335  | 0.2996  | 0.3324  | 0.5362  | 0.7869  | 0.9161  | 0.9573 (89)  |
| MIT 2                                                                       | 17.9373                   | 18.4220 | 18.9692 | 19.5843 | 19.9701 | 20.1758 | 20.2233 | 20.2205 | 20.1064 | 19.5882 | 18.6909 | 17.8782 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.0770                   | 18.5497 | 19.0837 | 19.6849 | 20.0641 | 20.2670 | 20.3151 | 20.3118 | 20.1977 | 19.6871 | 18.8104 | 18.0187 (92) |
| Temperature adjustment                                                      |                           |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 17.9270                   | 18.3997 | 18.9337 | 19.5349 | 19.9141 | 20.1170 | 20.1651 | 20.1618 | 20.0477 | 19.5371 | 18.6604 | 17.8687 (93) |

## 8. Space heating requirement

|                                                                                |                            |           |           |           |          |          |          |          |          |           |           |                |
|--------------------------------------------------------------------------------|----------------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|----------------|
|                                                                                | Jan                        | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec            |
| Utilisation                                                                    | 0.9280                     | 0.8833    | 0.8244    | 0.7220    | 0.5892   | 0.4253   | 0.2940   | 0.3261   | 0.5233   | 0.7594    | 0.8893    | 0.9371 (94)    |
| Useful gains                                                                   | 826.5125                   | 969.5595  | 1025.8298 | 1004.7463 | 863.1981 | 612.7615 | 407.3663 | 426.0443 | 641.1619 | 805.3945  | 807.8034  | 785.6457 (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                                                               | 1659.6857                  | 1638.0662 | 1503.0963 | 1261.5840 | 970.7004 | 639.4948 | 413.2460 | 434.3388 | 694.7957 | 1056.1460 | 1376.6100 | 1640.0317 (97) |
| Space heating kWh                                                              | 619.8809                   | 449.2365  | 355.0863  | 184.9232  | 79.9817  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 186.5591  | 409.5408  | 635.6631 (98a) |
| Space heating requirement - total per year (kWh/year)                          | 2920.8716                  |           |           |           |          |          |          |          |          |           |           |                |
| 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                                                              | 619.8809                   | 449.2365  | 355.0863  | 184.9232  | 79.9817  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 186.5591  | 409.5408  | 635.6631 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | 2920.8716                  |           |           |           |          |          |          |          |          |           |           |                |
| Space heating per m <sup>2</sup>                                               | (98c) / (4) = 20.6437 (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 %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 89.0000 (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                                                                            | 619.8809 | 449.2365 | 355.0863 | 184.9232 | 79.9817  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 186.5591 | 409.5408 | 635.6631 (98)  |
| Space heating efficiency (main heating system 1)                                                     | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 89.0000  | 89.0000  | 89.0000 (210)  |
| Space heating fuel (main heating system)                                                             | 696.4954 | 504.7601 | 398.9733 | 207.7788 | 89.8671  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 209.6170 | 460.1582 | 714.2283 (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                                                                            | 134.5384 | 118.0379 | 124.2316 | 107.8137 | 103.2674 | 91.8273  | 90.3183  | 94.9674  | 97.0754  | 109.6132 | 118.0437 | 132.9980 (64)  |
| Efficiency of water heater                                                                           | 88.6920  | 88.6408  | 88.5531  | 88.3663  | 88.0339  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 88.3632  | 88.6139  | 88.7011 (217)  |
| Fuel for water heating, kWh/month                                                                    | 151.6917 | 133.1642 | 140.2906 | 122.0078 | 117.3041 | 105.1860 | 103.4574 | 108.7828 | 111.1975 | 124.0485 | 133.2112 | 149.9395 (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                                                                                         | 30.2114  | 27.2878  | 30.2114  | 29.2369  | 30.2114  | 29.2369  | 30.2114  | 30.2114  | 29.2369  | 30.2114  | 29.2369  | 30.2114 (231)  |
| Lighting                                                                                             | 46.1171  | 36.9969  | 33.3116  | 24.4055  | 18.8515  | 15.4018  | 17.1970  | 22.3533  | 29.0347  | 38.0951  | 43.0283  | 47.3989 (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |          |          |          |          |          |          |          |          |                |
| (233a)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 (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                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (233b)  |

# Full SAP Calculation Printout



|                                                                                                      |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| 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    | (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    | (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    | (235d) |
| Annual totals kWh/year                                                                               |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
| Space heating fuel - main system 1                                                                   |        |        |        |        |        |        |        |        |        |        |        |        | 3281.8782 | (211)  |
| Space heating fuel - main system 2                                                                   |        |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (213)  |
| Space heating fuel - secondary                                                                       |        |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (215)  |
| Efficiency of water heater                                                                           |        |        |        |        |        |        |        |        |        |        |        |        | 87.3000   |        |
| Water heating fuel used                                                                              |        |        |        |        |        |        |        |        |        |        |        |        | 1500.2813 | (219)  |
| Space cooling fuel                                                                                   |        |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (221)  |
| Electricity for pumps and fans:                                                                      |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6250)                           |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
| mechanical ventilation fans (SFP = 0.6250)                                                           |        |        |        |        |        |        |        |        |        |        |        |        | 269.7153  | (230a) |
| central heating pump                                                                                 |        |        |        |        |        |        |        |        |        |        |        |        | 41.0000   | (230c) |
| main heating flue fan                                                                                |        |        |        |        |        |        |        |        |        |        |        |        | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                                                            |        |        |        |        |        |        |        |        |        |        |        |        | 355.7153  | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                  |        |        |        |        |        |        |        |        |        |        |        |        | 372.1916  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
| PV generation                                                                                        |        |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (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                                                                  |        |        |        |        |        |        |        |        |        |        |        |        | 6176.6620 | (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                   | 3281.8782          | 0.2100                        | 689.1944                 | (261)  |
| Total CO2 associated with community systems     |                    |                               | 0.0000                   | (373)  |
| Water heating (other fuel)                      | 1500.2813          | 0.2100                        | 315.0591                 | (264)  |
| Energy for instantaneous electric shower(s)     | 666.5957           | 0.1391                        | 92.7382                  | (264a) |
| Space and water heating                         |                    |                               | 1004.2535                | (265)  |
| Pumps, fans and electric keep-hot               | 355.7153           | 0.1387                        | 49.3421                  | (267)  |
| Energy for lighting                             | 372.1916           | 0.1443                        | 53.7187                  | (268)  |
| Total CO2, kg/year                              |                    |                               | 1200.0525                | (272)  |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 8.4800                   | (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               | 3281.8782          | 1.1300                              | 3708.5223                  | (275)  |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473)  |
| Water heating (other fuel)                  | 1500.2813          | 1.1300                              | 1695.3178                  | (278)  |
| Energy for instantaneous electric shower(s) | 666.5957           | 1.5143                              | 1009.4486                  | (278a) |
| Space and water heating                     |                    |                                     | 5403.8401                  | (279)  |
| Pumps, fans and electric keep-hot           | 355.7153           | 1.5128                              | 538.1261                   | (281)  |
| Energy for lighting                         | 372.1916           | 1.5338                              | 570.8799                   | (282)  |
| Total Primary energy kWh/year               |                    |                                     | 7522.2948                  | (286)  |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 53.1600                    | (287)  |

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

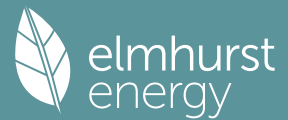
## 1. Overall dwelling characteristics

|                                                        | Area<br>(m2) | Storey height<br>(m)            | Volume<br>(m3)  |        |
|--------------------------------------------------------|--------------|---------------------------------|-----------------|--------|
| Ground floor                                           | 64.8000 (1b) | x 2.5000 (2b)                   | = 162.0000 (1b) | - (3b) |
| First floor                                            | 76.6900 (1c) | x 2.5000 (2c)                   | = 191.7250 (1c) | - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.4900     |                                 |                 | (4)    |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 353.7250      | (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                                                           | 4 * 10 =        | 40.0000 (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)+(7a)+(7b)+(7c) = | 40.0000 / (5) = | 0.1131 (8)   |
| Pressure test                                                                                 |                 | Yes          |
| Pressure Test Method                                                                          |                 | Blower Door  |

# Full SAP Calculation Printout



|                                                      |        |        |        |        |        |        |        |        |        |        |        |        |                                         |
|------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------------------------------|
| Measured/design AP50                                 |        |        |        |        |        |        |        |        |        |        |        |        | 5.0000 (17)                             |
| Infiltration rate                                    |        |        |        |        |        |        |        |        |        |        |        |        | 0.3631 (18)                             |
| Number of sides sheltered                            |        |        |        |        |        |        |        |        |        |        |        |        | 3 (19)                                  |
| Shelter factor                                       |        |        |        |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor |        |        |        |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) = 0.2814 (21)        |
| Wind speed                                           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |                                         |
| Wind factor                                          | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22)                                    |
| Adj infilt rate                                      | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a)                                   |
| Effective ac                                         | 0.3588 | 0.3517 | 0.3447 | 0.3095 | 0.3025 | 0.2673 | 0.2673 | 0.2603 | 0.2814 | 0.3025 | 0.3166 | 0.3306 | (22b)                                   |
|                                                      | 0.5644 | 0.5619 | 0.5594 | 0.5479 | 0.5458 | 0.5357 | 0.5357 | 0.5339 | 0.5396 | 0.5458 | 0.5501 | 0.5547 | (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 Semi-glazed door                            |             |                | 3.3800        | 1.0000           | 3.3800                       |                   | (26a)         |
| TER Opening Type (Uw = 1.20)                    |             |                | 16.8400       | 1.1450           | 19.2824                      |                   | (27)          |
| Ground floor                                    |             |                | 64.8000       | 0.1300           | 8.4240                       |                   | (28a)         |
| Exposed over garage                             |             |                | 14.9000       | 0.1300           | 1.9370                       |                   | (28b)         |
| External Walls                                  | 154.0520    | 20.2200        | 133.8320      | 0.1800           | 24.0898                      |                   | (29a)         |
| Wall to garage                                  | 16.3540     |                | 16.3540       | 0.1800           | 2.9437                       |                   | (29a)         |
| Roof at ceiling                                 | 64.9000     |                | 64.9000       | 0.1100           | 7.1390                       |                   | (30)          |
| Roof at slope                                   | 17.8800     |                | 17.8800       | 0.1100           | 1.9668                       |                   | (30)          |
| Total net area of external elements Aum (A, m2) |             |                | 332.8860      |                  |                              |                   | (31)          |
| Fabric heat loss, W/K = Sum (A x U)             |             |                |               |                  | (26)...(30) + (32) = 69.1627 |                   | (33)          |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

98.5185 (35)

### List of Thermal Bridges

|                                                                           | Length<br>m | Psi-value<br>W/m2K | Total<br>W/K                       |
|---------------------------------------------------------------------------|-------------|--------------------|------------------------------------|
| K1 Element                                                                | 18.3000     | 0.0500             | 0.9150                             |
| E2 Other lintels (including other steel lintels)                          | 16.9500     | 0.0500             | 0.8475                             |
| E3 Sill                                                                   | 34.4000     | 0.0500             | 1.7200                             |
| E4 Jamb                                                                   | 0.0000      | 0.0700             | 0.0000                             |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000      | 0.0000             | 0.0000                             |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000      | 0.0000             | 0.0000                             |
| E14 Flat roof                                                             | 0.0000      | 0.0800             | 0.0000                             |
| E16 Corner (normal)                                                       | 22.9000     | 0.0900             | 2.0610                             |
| E17 Corner (inverted - internal area greater than external area)          | 2.5000      | -0.0900            | -0.2250                            |
| E18 Party wall between dwellings                                          | 0.0000      | 0.0600             | 0.0000                             |
| E25 Staggered party wall between dwellings                                | 0.0000      | 0.0600             | 0.0000                             |
| E5 Ground floor (normal)                                                  | 29.8700     | 0.1600             | 4.7792                             |
| E6 Intermediate floor within a dwelling                                   | 29.8700     | 0.0000             | 0.0000                             |
| E10 Eaves (insulation at ceiling level)                                   | 16.4300     | 0.0600             | 0.9858                             |
| E12 Gable (insulation at ceiling level)                                   | 18.4800     | 0.0600             | 1.1088                             |
| E21 Exposed floor (inverted)                                              | 19.9300     | 0.3200             | 6.3776                             |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000      | 0.0000             | 0.0000                             |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000      | 0.1200             | 0.0000                             |
| P1 Party wall - Ground floor                                              | 0.0000      | 0.0800             | 0.0000                             |
| P2 Party wall - Intermediate floor within a dwelling                      | 0.0000      | 0.0000             | 0.0000                             |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |             |                    | 18.5699 (36)                       |
| Point Thermal bridges                                                     |             |                    | (36a) = 0.0000                     |
| Total fabric heat loss                                                    |             |                    | (33) + (36) + (36a) = 87.7326 (37) |

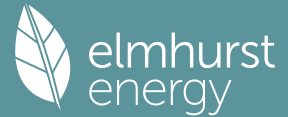
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           |          |          |          |          |          |          |          |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| (38)m                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |          |
| Heat transfer coeff       | 65.8771  | 65.5854  | 65.2994  | 63.9564  | 63.7051  | 62.5353  | 62.5353  | 62.3187  | 62.9859  | 63.7051  | 64.2134  | 64.7449  | (38)     |
| Average = Sum(39)m / 12 = | 153.6097 | 153.3180 | 153.0321 | 151.6890 | 151.4377 | 150.2680 | 150.2680 | 150.0513 | 150.7185 | 151.4377 | 151.9461 | 152.4775 | (39)     |
|                           |          |          |          |          |          |          |          |          |          |          |          |          | 151.6878 |
| HLP                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |          |
| HLP (average)             | 1.0857   | 1.0836   | 1.0816   | 1.0721   | 1.0703   | 1.0620   | 1.0620   | 1.0605   | 1.0652   | 1.0703   | 1.0739   | 1.0777   | (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                                               |          |          |          |          |          |          |          |          |          |          |          |          | 2.9199 (42)    |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |          |          |          |                |
| Hot water usage for baths                                       | 73.1764  | 72.0767  | 70.4742  | 67.4082  | 65.1455  | 62.6222  | 61.1880  | 62.7783  | 64.5216  | 67.2309  | 70.3628  | 72.8961  | (42a)          |
| Hot water usage for other uses                                  | 31.5915  | 31.1223  | 30.4616  | 29.2434  | 28.3312  | 27.3197  | 26.7734  | 27.4295  | 28.1438  | 29.2261  | 30.4694  | 31.4847  | (42b)          |
| Average daily hot water use (litres/day)                        | 44.5324  | 42.9130  | 41.2936  | 39.6743  | 38.0549  | 36.4356  | 36.4356  | 38.0549  | 39.6743  | 41.2936  | 42.9130  | 44.5324  | (42c)          |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          | 137.2405 (43)  |
| Daily hot water use                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                |
| Energy conte                                                    | 149.3003 | 146.1120 | 142.2295 | 136.3259 | 131.5317 | 126.3775 | 124.3969 | 128.2627 | 132.3397 | 137.7507 | 143.7452 | 148.9131 | (44)           |
| Energy content (annual)                                         | 236.4551 | 208.0616 | 218.6014 | 186.6233 | 177.0669 | 155.3959 | 150.4473 | 158.8160 | 163.1881 | 186.9264 | 204.7915 | 233.1619 | (45)           |
| Distribution loss (46)m = 0.15 x (45)m                          | 35.4683  | 31.2092  | 32.7902  | 27.9935  | 26.5600  | 23.3094  | 22.5671  | 23.8224  | 24.4782  | 28.0390  | 30.7187  | 34.9743  | (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                                                      | 50.9589  | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | (61)           |
| Total heat required for water heating calculated for each month | 287.4140 | 254.0890 | 269.5603 | 235.9384 | 228.0258 | 204.7110 | 201.4062 | 209.7749 | 212.5032 | 237.8853 | 254.1065 | 284.1208 | (62)           |
| WWHRS                                                           | -33.4532 | -29.5863 | -30.9811 | -25.6535 | -23.9082 | -20.4584 | -19.1765 | -20.3923 | -21.1670 | -24.9536 | -28.2694 | -32.8337 | (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                                                 | 253.9608 | 224.5027 | 238.5793 | 210.2848 | 204.1176 | 184.2526 | 182.2297 | 189.3827 | 191.3362 | 212.9317 | 225.8371 | 251.2871 | (64)           |
| 12Total per year (kWh/year)                                     |          |          |          |          |          |          |          |          |          |          |          |          | 2568.7023 (64) |
| Electric shower(s)                                              |          |          |          |          |          |          |          |          |          |          |          |          | 2569 (64)      |

# Full SAP Calculation Printout



|                                          |                                                                                |         |         |         |         |         |         |         |         |         |         |              |
|------------------------------------------|--------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
|                                          | 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 | 91.3611                                                                        | 80.6873 | 85.4247 | 74.3810 | 71.6145 | 63.9979 | 62.7635 | 65.5461 | 66.5888 | 74.8927 | 80.4219 | 90.2661 (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                                                                               | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 174.4857  | 193.1806  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.0999  | 314.3281  | 306.1930  | 288.8744  | 267.0128  | 246.4660  | 232.7394  | 229.5112  | 237.6462  | 254.9648  | 276.8265  | 297.3733 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993 (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    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 (71) |
| Water heating gains (Table 5)                                                       | 122.7971  | 120.0704  | 114.8181  | 103.3070  | 96.2560   | 88.8860   | 84.3595   | 88.0995   | 92.4845   | 100.6623  | 111.6971  | 121.3254 (72)  |
| Total internal gains                                                                | 678.1807  | 697.3772  | 665.2949  | 642.2813  | 607.5526  | 582.4519  | 558.3827  | 558.8945  | 577.2307  | 599.9109  | 638.6235  | 662.9824 (73)  |

## 6. Solar gains

| [Jan]       |          |          |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |               |
|-------------|----------|----------|-----------|-----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|---------------|---------------|
| North       |          |          |           |           | 2.1600     | 10.6334                        |           | 0.6300                            | 0.7000                             | 0.7700                       | 7.0194 (74)   |               |
| East        |          |          |           |           | 6.6200     | 19.6403                        |           | 0.6300                            | 0.7000                             | 0.7700                       | 39.7354 (76)  |               |
| South       |          |          |           |           | 8.0600     | 46.7521                        |           | 0.6300                            | 0.7000                             | 0.7700                       | 115.1616 (78) |               |
| Solar gains | 161.9163 | 279.7502 | 391.0551  | 494.8445  | 561.0812   | 559.3281                       | 538.3441  | 489.0346                          | 427.2576                           | 311.6304                     | 194.7104      | 138.0383 (83) |
| Total gains | 840.0970 | 977.1273 | 1056.3501 | 1137.1259 | 1168.6338  | 1141.7800                      | 1096.7267 | 1047.9291                         | 1004.4883                          | 911.5412                     | 833.3339      | 801.0207 (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                                                                | 25.2071 | 25.2550 | 25.3022 | 25.5262 | 25.5686 | 25.7676 | 25.7676 | 25.8048 | 25.6906 | 25.5686 | 25.4831 | 25.3942      |
| alpha                                                              | 2.6805  | 2.6837  | 2.6868  | 2.7017  | 2.7046  | 2.7178  | 2.7178  | 2.7203  | 2.7127  | 2.7046  | 2.6989  | 2.6929       |
| util living area                                                   | 0.9657  | 0.9480  | 0.9237  | 0.8743  | 0.7941  | 0.6657  | 0.5315  | 0.5671  | 0.7432  | 0.8894  | 0.9492  | 0.9696 (86)  |
| MIT                                                                | 18.3906 | 18.7042 | 19.1479 | 19.7424 | 20.2814 | 20.6974 | 20.8825 | 20.8559 | 20.5603 | 19.8568 | 19.0264 | 18.3369 (87) |
| Th 2                                                               | 20.0126 | 20.0143 | 20.0159 | 20.0237 | 20.0252 | 20.0320 | 20.0320 | 20.0332 | 20.0293 | 20.0252 | 20.0222 | 20.0191 (88) |
| util rest of house                                                 | 0.9607  | 0.9405  | 0.9122  | 0.8538  | 0.7571  | 0.6001  | 0.4361  | 0.4740  | 0.6867  | 0.8674  | 0.9405  | 0.9651 (89)  |
| MIT 2                                                              | 16.9457 | 17.3431 | 17.9038 | 18.6493 | 19.3035 | 19.7795 | 19.9599 | 19.9398 | 19.6372 | 18.8030 | 17.7607 | 16.8814 (90) |
| Living area fraction                                               | 17.1214 | 17.5085 | 18.0551 | 18.7822 | 19.4224 | 19.8911 | 20.0721 | 20.0512 | 19.7494 | 18.9311 | 17.9146 | 17.0583 (91) |
| MIT                                                                | 17.1214 | 17.5085 | 18.0551 | 18.7822 | 19.4224 | 19.8911 | 20.0721 | 20.0512 | 19.7494 | 18.9311 | 17.9146 | 17.0583 (92) |
| Temperature adjustment                                             |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                       | 17.1214 | 17.5085 | 18.0551 | 18.7822 | 19.4224 | 19.8911 | 20.0721 | 20.0512 | 19.7494 | 18.9311 | 17.9146 | 17.0583 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|-----------|----------------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
|                                                                                | 0.9389    | 0.9138    | 0.8814    | 0.8213    | 0.7303    | 0.5894   | 0.4404   | 0.4759   | 0.6678   | 0.8354        | 0.9142    | 0.9449 (94)    |
| Useful gains                                                                   | 788.7777  | 892.8632  | 931.0541  | 933.9329  | 853.4798  | 673.0072 | 482.9765 | 498.6728 | 670.8242 | 761.5276      | 761.8080  | 756.8727 (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                                                               | 1969.4894 | 1933.1176 | 1768.2956 | 1499.0232 | 1169.4646 | 795.0828 | 521.7434 | 547.8682 | 851.4703 | 1261.6464     | 1643.2313 | 1960.6008 (97) |
| Space heating kWh                                                              | 878.4495  | 699.0509  | 622.9077  | 406.8650  | 235.0927  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 372.0884      | 634.6247  | 895.5737 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |               |           | 4744.6527      |
| 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                                                              | 878.4495  | 699.0509  | 622.9077  | 406.8650  | 235.0927  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 372.0884      | 634.6247  | 895.5737 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |               |           | 4744.6527      |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          | (98c) / (4) = |           | 33.5335 (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 %)                      |          |          |          |          |          |        |        |        |        |          | 92.4000 (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                                             | 878.4495 | 699.0509 | 622.9077 | 406.8650 | 235.0927 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 372.0884 | 634.6247      | 895.5737 (98)  |
| Space heating efficiency (main heating system 1)                      | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.4000  | 92.4000       | 92.4000 (210)  |
| Space heating fuel (main heating system)                              | 950.7029 | 756.5486 | 674.1426 | 440.3301 | 254.4293 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 402.6930 | 686.8233      | 969.2356 (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)                            |          |          |          |          |          |        |        |        |        |          |               |                |

# Full SAP Calculation Printout



|                                                                                                      |          |          |           |           |           |           |           |           |           |           |          |                  |
|------------------------------------------------------------------------------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|------------------|
| 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 (213)     |
|                                                                                                      | 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                                                                            | 253.9608 | 224.5027 | 238.5793  | 210.2848  | 204.1176  | 184.2526  | 182.2297  | 189.3827  | 191.3362  | 212.9317  | 225.8371 | 251.2871 (64)    |
| Efficiency of water heater (217)m                                                                    | 86.8148  | 86.6443  | 86.3392   | 85.7701   | 84.6850   | 80.3000   | 80.3000   | 80.3000   | 80.3000   | 85.5646   | 86.4694  | 80.3000 (216)    |
| Fuel for water heating, kWh/month                                                                    | 292.5316 | 259.1085 | 276.3279  | 245.1728  | 241.0316  | 229.4553  | 226.9361  | 235.8439  | 238.2767  | 248.8548  | 261.1757 | 86.8617 (217)    |
| 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   | 289.2957 (219)   |
| (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                                                                                         | 7.3041   | 6.5973   | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041    | 7.0685   | 7.3041 (231)     |
| Lighting                                                                                             | 36.2547  | 29.0849  | 26.1877   | 19.1862   | 14.8200   | 12.1081   | 13.5193   | 17.5729   | 22.8254   | 29.9482   | 33.8264  | 37.2623 (232)    |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -58.2626 | -80.9337 | -114.5871 | -126.7565 | -134.8474 | -125.0970 | -123.4577 | -117.4111 | -106.5203 | -91.4992  | -63.5889 | -50.5062 (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)                                        | -36.6173 | -76.5980 | -151.5070 | -226.5350 | -298.6222 | -299.8182 | -296.3742 | -251.4164 | -184.8584 | -109.2950 | -48.7974 | -28.9956 (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                                                                   |          |          |           |           |           |           |           |           |           |           |          | 5134.9055 (211)  |
| Space heating fuel - main system 2                                                                   |          |          |           |           |           |           |           |           |           |           |          | 0.0000 (213)     |
| Space heating fuel - secondary                                                                       |          |          |           |           |           |           |           |           |           |           |          | 0.0000 (215)     |
| Efficiency of water heater                                                                           |          |          |           |           |           |           |           |           |           |           |          | 80.3000          |
| Water heating fuel used                                                                              |          |          |           |           |           |           |           |           |           |           |          | 3044.0105 (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)                                                  |          |          |           |           |           |           |           |           |           |           |          | 292.5961 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |           |           |           |           |           |           |           |           |          |                  |
| PV generation                                                                                        |          |          |           |           |           |           |           |           |           |           |          | -3202.9025 (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                                                                  |          |          |           |           |           |           |           |           |           |           |          | 5354.6096 (238)  |

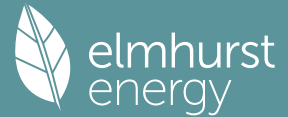
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 5134.9055          | 0.2100                        | 1078.3301 (261)          |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 3044.0105          | 0.2100                        | 639.2422 (264)           |
| Space and water heating                       |                    |                               | 1717.5724 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 292.5961           | 0.1443                        | 42.2307 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -1193.4676         | 0.1349                        | -161.0433                |
| PV Unit electricity exported                  | -2009.4349         | 0.1260                        | -253.2314                |
| Total                                         |                    |                               | -414.2747 (269)          |
| Total CO2, kg/year                            |                    |                               | 1357.4575 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 9.5900 (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               | 5134.9055          | 1.1300                              | 5802.4432 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 3044.0105          | 1.1300                              | 3439.7319 (278)            |
| Space and water heating                     |                    |                                     | 9242.1751 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 292.5961           | 1.5338                              | 448.7937 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -1193.4676         | 1.4987                              | -1788.6802                 |
| PV Unit electricity exported                | -2009.4349         | 0.4626                              | -929.5434                  |
| Total                                       |                    |                                     | -2718.2236 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 7102.8460 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 50.2000 (287)              |

# Full SAP Calculation Printout



|                                    |                        |               |       |      |                |            |
|------------------------------------|------------------------|---------------|-------|------|----------------|------------|
| Property Reference                 | 4029 4B8P det          |               |       |      | Issued on Date | 22/11/2024 |
| Assessment Reference               | LZC                    | Prop Type Ref |       |      |                |            |
| Property                           | 4029 4B8P det,         |               |       |      |                |            |
|                                    |                        |               |       |      |                |            |
| SAP Rating                         | 85 B                   | DER           | 2.56  | TER  | 9.45           |            |
| Environmental                      | 97 A                   | % DER < TER   |       |      |                | 72.91      |
| CO <sub>2</sub> Emissions (t/year) | 0.34                   | DFEE          | 33.20 | TFEE | 38.33          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |      |                | 13.39      |
| % DPER < TPER                      | 45.63                  | DPER          | 26.88 | TPER | 49.45          |            |
|                                    |                        |               |       |      |                |            |
| Assessor Details                   | Mr. Michael Woodbridge |               |       |      | Assessor ID    | M818-0001  |
| Client                             |                        |               |       |      |                |            |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 64.8000 (1b)              | x 2.5000 (2b)                   | = 162.0000 (1b) - (3b)      |
| First floor                                            | 76.6900 (1c)              | x 2.5000 (2c)                   | = 191.7250 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 141.4900                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 353.7250 (5)              |

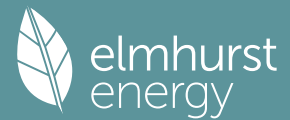
## 2. Ventilation rate

|                                                                                                         |        |        |        |        |        |        |        |        |        |        |                             |              |
|---------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------------------|--------------|
|                                                                                                         |        |        |        |        |        |        |        |        |        |        | 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                                                                                    |        |        |        |        |        |        |        |        |        |        | 4.0000 (17)                 |              |
| Infiltration rate                                                                                       |        |        |        |        |        |        |        |        |        |        | 0.2000 (18)                 |              |
| Number of sides sheltered                                                                               |        |        |        |        |        |        |        |        |        |        | 3 (19)                      |              |
| Shelter factor                                                                                          |        |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20)  |
| Infiltration rate adjusted to include shelter factor                                                    |        |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) =        | 0.1550 (21)  |
|                                                                                                         |        |        |        |        |        |        |        |        |        |        |                             |              |
| Wind speed                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov                         | Dec          |
| Wind factor                                                                                             | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000                      | 4.7000 (22)  |
| 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                                                                                         |        |        |        |        |        |        |        |        |        |        |                             |              |
|                                                                                                         | 0.1976 | 0.1938 | 0.1899 | 0.1705 | 0.1666 | 0.1473 | 0.1473 | 0.1434 | 0.1550 | 0.1666 | 0.1744                      | 0.1821 (22b) |
| Balanced mechanical ventilation with heat recovery                                                      |        |        |        |        |        |        |        |        |        |        |                             |              |
| If mechanical ventilation                                                                               |        |        |        |        |        |        |        |        |        |        |                             |              |
|                                                                                                         |        |        |        |        |        |        |        |        |        |        |                             |              |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |                             |              |
|                                                                                                         |        |        |        |        |        |        |        |        |        |        |                             |              |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |                             |              |
|                                                                                                         |        |        |        |        |        |        |        |        |        |        |                             |              |
| Effective ac                                                                                            | 0.3457 | 0.3419 | 0.3380 | 0.3186 | 0.3147 | 0.2954 | 0.2954 | 0.2915 | 0.3031 | 0.3147 | 0.3225                      | 0.3302 (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   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| W1 (Uw = 0.80)                                              |                         |                            | 2.1600                    | 0.7752                        | 1.6744       |                                | (27)            |
| W2 (Uw = 0.80)                                              |                         |                            | 5.6700                    | 0.7752                        | 4.3953       |                                | (27)            |
| W3 (Uw = 0.80)                                              |                         |                            | 0.9500                    | 0.7752                        | 0.7364       |                                | (27)            |
| W4 (Uw = 0.80)                                              |                         |                            | 1.4400                    | 0.7752                        | 1.1163       |                                | (27)            |
| W5 (Uw = 0.80)                                              |                         |                            | 5.6700                    | 0.7752                        | 4.3953       |                                | (27)            |
| W6 (Uw = 0.80)                                              |                         |                            | 0.9500                    | 0.7752                        | 0.7364       |                                | (27)            |
| Front Door                                                  |                         |                            | 3.3800                    | 1.0000                        | 3.3800       |                                | (26a)           |
| Ground floor                                                |                         |                            | 64.8000                   | 0.1200                        | 7.7760       | 110.0000                       | 7128.0000 (28a) |
| Exposed over garage                                         |                         |                            | 14.9000                   | 0.1200                        | 1.7880       | 20.0000                        | 298.0000 (28b)  |
| External Walls                                              | 154.0520                | 20.2200                    | 133.8320                  | 0.1500                        | 20.0748      | 9.0000                         | 1204.4880 (29a) |
| Wall to garage                                              | 16.3540                 |                            | 16.3540                   | 0.1400                        | 2.2896       | 60.0000                        | 981.2400 (29a)  |
| Roof at ceiling                                             | 64.9000                 |                            | 64.9000                   | 0.1100                        | 7.1390       | 9.0000                         | 584.1000 (30)   |
| Roof at slope                                               | 17.8800                 |                            | 17.8800                   | 0.1800                        | 3.2184       | 9.0000                         | 160.9200 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 332.8860                  |                               |              |                                | (31)            |

# Full SAP Calculation Printout



|                                     |                      |         |         |                 |
|-------------------------------------|----------------------|---------|---------|-----------------|
| Fabric heat loss, W/K = Sum (A x U) | (26)...(30) + (32) = | 58.7200 |         | (33)            |
| Internal Walls                      | 237.6600             |         | 9.0000  | 2138.9400 (32c) |
| Internal floor                      | 53.4700              |         | 18.0000 | 962.4600 (32d)  |
| Internal ceiling                    | 53.4700              |         | 9.0000  | 481.2300 (32e)  |

|                                                   |                                      |                 |
|---------------------------------------------------|--------------------------------------|-----------------|
| Heat capacity Cm = Sum(A x k)                     | (28)...(30) + (32) + (32a)...(32e) = | 13939.3781 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K |                                      | 98.5185 (35)    |

|                                                                           |                       |           |              |  |
|---------------------------------------------------------------------------|-----------------------|-----------|--------------|--|
| List of Thermal Bridges                                                   | Length                | Psi-value | Total        |  |
| K1 Element                                                                | 18.3000               | 0.3000    | 5.4900       |  |
| E2 Other lintels (including other steel lintels)                          | 16.9500               | 0.0400    | 0.6780       |  |
| E3 Sill                                                                   | 34.4000               | 0.0500    | 1.7200       |  |
| E4 Jamb                                                                   | 0.0000                | 0.0700    | 0.0000       |  |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000                | 0.1000    | 0.0000       |  |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000                | 0.1600    | 0.0000       |  |
| E14 Flat roof                                                             | 22.9000               | 0.0900    | 2.0610       |  |
| E16 Corner (normal)                                                       | 2.5000                | -0.0900   | -0.2250      |  |
| E17 Corner (inverted - internal area greater than external area)          | 0.0000                | 0.0600    | 0.0000       |  |
| E18 Party wall between dwellings                                          | 0.0000                | 0.2400    | 0.0000       |  |
| E25 Staggered party wall between dwellings                                | 29.8700               | 0.0510    | 1.5234       |  |
| E5 Ground floor (normal)                                                  | 29.8700               | 0.0110    | 0.3286       |  |
| E6 Intermediate floor within a dwelling                                   | 16.4300               | 0.0200    | 0.3286       |  |
| E10 Baves (insulation at ceiling level)                                   | 18.4800               | 0.2400    | 4.4352       |  |
| E12 Gable (insulation at ceiling level)                                   | 19.9300               | 0.3200    | 6.3776       |  |
| E21 Exposed floor (inverted)                                              | 0.0000                | 0.0000    | 0.0000       |  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000                | 0.0340    | 0.0000       |  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000                | 0.3200    | 0.0000       |  |
| P1 Party wall - Ground floor                                              | 0.0000                | 0.0000    | 0.0000       |  |
| P2 Party wall - Intermediate floor within a dwelling                      |                       |           |              |  |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |                       |           | 22.7173 (36) |  |
| Point Thermal bridges                                                     |                       |           | 0.0000       |  |
| Total fabric heat loss                                                    | (33) + (36) + (36a) = |           | 81.4374 (37) |  |

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (38)m                                                               | 40.3562  | 39.9039  | 39.4516  | 37.1899  | 36.7376  | 34.4760  | 34.4760  | 34.0237  | 35.3806  | 36.7376  | 37.6423  | 38.5469  | (38) |
| Heat transfer coeff                                                 | 121.7936 | 121.3413 | 120.8889 | 118.6273 | 118.1750 | 115.9134 | 115.9134 | 115.4610 | 116.8180 | 118.1750 | 119.0796 | 119.9843 | (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 118.5142 |      |
| HLP                                                                 | 0.8608   | 0.8576   | 0.8544   | 0.8384   | 0.8352   | 0.8192   | 0.8192   | 0.8160   | 0.8256   | 0.8352   | 0.8416   | 0.8480   | (40) |
| HLP (average)                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.8376   |      |
| Days in month                                                       | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

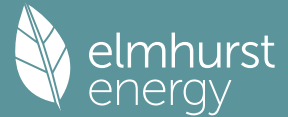
## 4. Water heating energy requirements (kWh/year)

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |           |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          |           | 2.9199 (42) |
| Hot water usage for mixer showers                                              | 73.1764  | 72.0767  | 70.4742  | 67.4082  | 65.1455  | 62.6222  | 61.1880  | 62.7783  | 64.5216  | 67.2309  | 70.3628  | 72.8961   | (42a)       |
| Hot water usage for baths                                                      | 31.5915  | 31.1223  | 30.4616  | 29.2434  | 28.3312  | 27.3197  | 26.7734  | 27.4295  | 28.1438  | 29.2261  | 30.4694  | 31.4847   | (42b)       |
| Hot water usage for other uses                                                 | 44.5324  | 42.9130  | 41.2936  | 39.6743  | 38.0549  | 36.4356  | 36.4356  | 38.0549  | 39.6743  | 41.2936  | 42.9130  | 44.5324   | (42c)       |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          | 137.2405  | (43)        |
| Daily hot water use                                                            | 149.3003 | 146.1120 | 142.2295 | 136.3259 | 131.5317 | 126.3775 | 124.3969 | 128.2627 | 132.3397 | 137.7507 | 143.7452 | 148.9131  | (44)        |
| Energy conte                                                                   | 236.4551 | 208.0616 | 218.6014 | 186.6233 | 177.0669 | 155.3959 | 150.4473 | 158.8160 | 163.1881 | 186.9264 | 204.7915 | 233.1619  | (45)        |
| Energy content (annual)                                                        |          |          |          |          |          |          |          |          |          |          |          | 2279.5355 |             |
| Distribution loss (46)m = 0.15 x (45)m                                         | 35.4683  | 31.2092  | 32.7902  | 27.9935  | 26.5600  | 23.3094  | 22.5671  | 23.8224  | 24.4782  | 28.0390  | 30.7187  | 34.9743   | (46)        |
| Water storage loss:                                                            |          |          |          |          |          |          |          |          |          |          |          |           |             |
| Store volume                                                                   |          |          |          |          |          |          |          |          |          |          |          | 200.0000  | (47)        |
| a) If manufacturer declared loss factor is known (kWh/day):                    |          |          |          |          |          |          |          |          |          |          |          | 1.3200    | (48)        |
| Temperature factor from Table 2b                                               |          |          |          |          |          |          |          |          |          |          |          | 0.6000    | (49)        |
| Enter (49) or (54) in (55)                                                     |          |          |          |          |          |          |          |          |          |          |          | 0.7920    | (55)        |
| Total storage loss                                                             | 24.5520  | 22.1760  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520   | (56)        |
| If cylinder contains dedicated solar storage                                   | 24.5520  | 22.1760  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520  | 24.5520  | 23.7600  | 24.5520  | 23.7600  | 24.5520   | (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                | 284.2695 | 251.2488 | 266.4158 | 232.8953 | 224.8813 | 201.6679 | 198.2617 | 206.6304 | 209.4601 | 234.7408 | 251.0635 | 280.9763  | (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                                                                | 284.2695 | 251.2488 | 266.4158 | 232.8953 | 224.8813 | 201.6679 | 198.2617 | 206.6304 | 209.4601 | 234.7408 | 251.0635 | 280.9763  | (64)        |
| Total per year (kWh/year)                                                      |          |          |          |          |          |          |          |          |          |          |          | 2842.5115 | (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                                       | 116.8728 | 103.7302 | 110.9365 | 99.0698  | 97.1263  | 88.6867  | 88.2753  | 91.0579  | 91.2777  | 100.4045 | 105.1108 | 115.7779  | (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                                                                               | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 174.4857  | 193.1806  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.0999  | 314.3281  | 306.1930  | 288.8744  | 267.0128  | 246.4660  | 232.7394  | 229.5112  | 237.6462  | 254.9648  | 276.8265  | 297.3733  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | (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)                                 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | (71) |
| Water heating gains (Table 5)                                                       | 157.0872  | 154.3605  | 149.1082  | 137.5970  | 130.5461  | 123.1760  | 118.6495  | 122.3896  | 126.7745  | 134.9523  | 145.9872  | 155.6154  | (72) |

# Full SAP Calculation Printout



Total internal gains  
709.4708 728.6672 696.5850 673.5714 638.8426 616.7419 592.6727 593.1845 611.5207 631.2009 669.9136 694.2725 (73)

## 6. Solar gains

| [Jan]       |          |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |           |           |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|-----------|-----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|-----------|-----------|----------|------------------------------|---------------|
| -----       |          |           |           |           |            |                                |                                   |                                    |           |           |          |                              |               |
| North       |          |           |           |           | 2.1600     | 10.6334                        | 0.6300                            | 0.0000                             |           |           |          | 0.7700                       | 11.1418 (74)  |
| South       |          |           |           |           | 5.6700     | 46.7521                        | 0.6300                            | 0.0000                             |           |           |          | 0.7700                       | 128.5923 (78) |
| South       |          |           |           |           | 0.9500     | 46.7521                        | 0.6300                            | 0.0000                             |           |           |          | 0.7700                       | 21.5455 (78)  |
| South       |          |           |           |           | 1.4400     | 46.7521                        | 0.6300                            | 0.0000                             |           |           |          | 0.7700                       | 32.6584 (78)  |
| East        |          |           |           |           | 5.6700     | 19.6403                        | 0.6300                            | 0.0000                             |           |           |          | 0.7700                       | 54.0209 (76)  |
| East        |          |           |           |           | 0.9500     | 19.6403                        | 0.6300                            | 0.0000                             |           |           |          | 0.7700                       | 9.0511 (76)   |
| -----       |          |           |           |           |            |                                |                                   |                                    |           |           |          |                              |               |
| Solar gains | 257.0100 | 444.0479  | 620.7224  | 785.4675  | 890.6051   | 887.8224                       | 854.5144                          | 776.2454                           | 678.1867  | 494.6514  | 309.0641 | 219.1085                     | (83)          |
| Total gains | 966.4808 | 1172.7151 | 1317.3074 | 1459.0389 | 1529.4477  | 1504.5644                      | 1447.1871                         | 1369.4299                          | 1289.7074 | 1125.8523 | 978.9776 | 913.3809                     | (84)          |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 31.7919 | 31.9104 | 32.0298 | 32.6405 | 32.7654 | 33.4047 | 33.4047 | 33.5356 | 33.1460 | 32.7654 | 32.5165 | 32.2713      |
| alpha                                                                       | 3.1195  | 3.1274  | 3.1353  | 3.1760  | 3.1844  | 3.2270  | 3.2270  | 3.2357  | 3.2097  | 3.1844  | 3.1678  | 3.1514       |
| util living area                                                            | 0.9460  | 0.9078  | 0.8536  | 0.7543  | 0.6243  | 0.4662  | 0.3444  | 0.3766  | 0.5648  | 0.7932  | 0.9128  | 0.9531 (86)  |
| MIT                                                                         | 19.1886 | 19.5599 | 19.9808 | 20.4535 | 20.7645 | 20.9335 | 20.9810 | 20.9746 | 20.8727 | 20.4511 | 19.7587 | 19.1381 (87) |
| Th 2                                                                        | 20.2010 | 20.2037 | 20.2064 | 20.2202 | 20.2229 | 20.2367 | 20.2367 | 20.2395 | 20.2312 | 20.2229 | 20.2174 | 20.2119 (88) |
| util rest of house                                                          | 0.9392  | 0.8970  | 0.8370  | 0.7281  | 0.5865  | 0.4171  | 0.2874  | 0.3180  | 0.5145  | 0.7648  | 0.9009  | 0.9472 (89)  |
| MIT 2                                                                       | 18.0651 | 18.5305 | 19.0528 | 19.6327 | 19.9920 | 20.1822 | 20.2249 | 20.2228 | 20.1204 | 19.6440 | 18.7951 | 18.0088 (90) |
| Living area fraction                                                        | 18.2017 | 18.6556 | 19.1656 | 19.7324 | 20.0859 | 20.2736 | 20.3168 | 20.3142 | 20.2118 | 19.7421 | 18.9122 | 18.1461 (92) |
| MIT                                                                         | 18.2017 | 18.6556 | 19.1656 | 19.7324 | 20.0859 | 20.2736 | 20.3168 | 20.3142 | 20.2118 | 19.7421 | 18.9122 | 0.0000       |
| Temperature adjustment                                                      | 18.2017 | 18.6556 | 19.1656 | 19.7324 | 20.0859 | 20.2736 | 20.3168 | 20.3142 | 20.2118 | 19.7421 | 18.9122 | 18.1461 (93) |
| adjusted MIT                                                                | 18.2017 | 18.6556 | 19.1656 | 19.7324 | 20.0859 | 20.2736 | 20.3168 | 20.3142 | 20.2118 | 19.7421 | 18.9122 | 18.1461 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9171    | 0.8714    | 0.8118    | 0.7102    | 0.5795   | 0.4195   | 0.2935   | 0.3238   | 0.5132   | 0.7451        | 0.8762    | 0.9267 (94)    |
| Useful gains                                                                   | 886.3750  | 1021.9445 | 1069.4521 | 1036.2676 | 886.3698 | 631.2230 | 424.7243 | 443.4826 | 661.8850 | 838.8650      | 857.8009  | 846.4005 (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                                                               | 1693.1323 | 1669.1236 | 1531.1359 | 1285.0230 | 991.0078 | 657.6421 | 430.8240 | 451.9406 | 713.9730 | 1080.3637     | 1406.5936 | 1673.3101 (97) |
| Space heating kWh                                                              | 600.2275  | 434.9043  | 343.4927  | 179.1039  | 77.8507  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 179.6750      | 395.1308  | 615.2208 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 2825.6056      |
| 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                                                              | 600.2275  | 434.9043  | 343.4927  | 179.1039  | 77.8507  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 179.6750      | 395.1308  | 615.2208 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 2825.6056      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 19.9704 (99)   |

## 9b. Energy requirements

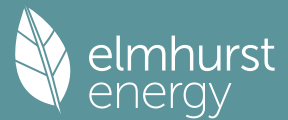
|                                                                                         |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (301)   |
| Fraction of space heat from community system                                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (302)   |
| Fraction of heat from community Heat pump-Space and Water                               |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (303a)  |
| Factor for control and charging method (Table 4c(3)) for space heating                  |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (305)   |
| Factor for charging method (Table 4c(3)) for water heating                              |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (305a)  |
| Distribution loss factor (Table 12c) for community heating system                       |          |          |          |          |          |          |          |          |          |          |          | 1.1000 (306)   |
| Efficiency of secondary/supplementary heating system, %                                 |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)   |
| Space heating:                                                                          |          |          |          |          |          |          |          |          |          |          |          |                |
| Space heating requirement                                                               | 600.2275 | 434.9043 | 343.4927 | 179.1039 | 77.8507  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 179.6750 | 395.1308 | 615.2208 (98)  |
| Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.10                                   |          |          |          |          |          |          |          |          |          |          |          |                |
| 307a                                                                                    | 660.2502 | 478.3948 | 377.8420 | 197.0142 | 85.6357  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 197.6425 | 434.6439 | 676.7428       |
| Space heating requirement                                                               | 660.2502 | 478.3948 | 377.8420 | 197.0142 | 85.6357  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 197.6425 | 434.6439 | 676.7428 (307) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (308)   |
| Space heating fuel for secondary/supplementary system                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (309)   |
| Water heating                                                                           |          |          |          |          |          |          |          |          |          |          |          |                |
| Annual water heating requirement                                                        | 284.2695 | 251.2488 | 266.4158 | 232.8953 | 224.8813 | 201.6679 | 198.2617 | 206.6304 | 209.4601 | 234.7408 | 251.0635 | 280.9763 (64)  |
| Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.10                                   |          |          |          |          |          |          |          |          |          |          |          |                |
| 310a                                                                                    | 312.6965 | 276.3737 | 293.0574 | 256.1848 | 247.3694 | 221.8347 | 218.0879 | 227.2935 | 230.4062 | 258.2148 | 276.1698 | 309.0740       |
| Water heating fuel                                                                      | 312.6965 | 276.3737 | 293.0574 | 256.1848 | 247.3694 | 221.8347 | 218.0879 | 227.2935 | 230.4062 | 258.2148 | 276.1698 | 309.0740 (310) |
| Cooling System Energy Efficiency Ratio                                                  |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (314)   |
| Space coolin                                                                            | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (315)   |
| Pumps and Fa                                                                            | 22.9073  | 20.6905  | 22.9073  | 22.1684  | 22.9073  | 22.1684  | 22.9073  | 22.9073  | 22.1684  | 22.9073  | 22.1684  | 22.9073 (331)  |
| Lighting                                                                                | 46.1171  | 36.9969  | 33.3116  | 24.4055  | 18.8515  | 15.4018  | 17.1970  | 22.3533  | 29.0347  | 38.0951  | 43.0283  | 47.3989 (332)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                           |          |          |          |          |          |          |          |          |          |          |          |                |
| (333a)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 (333a)  |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                 |          |          |          |          |          |          |          |          |          |          |          |                |
| (334a)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 (334a)  |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)     |          |          |          |          |          |          |          |          |          |          |          |                |
| (335a)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 (335a)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                           |          |          |          |          |          |          |          |          |          |          |          |                |
| (333b)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 (333b)  |



elmhurst  
energy

| 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                                                                | 4 * 10 =        | 40.0000     | (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) = | 40.0000 / (5) = | 0.1131      | (8)                  |
| Pressure test                                                                                      |                 | Yes         |                      |
| Pressure Test Method                                                                               |                 | Blower Door |                      |
| Measured/design AP50                                                                               |                 | 5.0000      | (17)                 |
| Infiltration rate                                                                                  |                 | 0.3631      | (18)                 |

# Full SAP Calculation Printout



Number of sides sheltered

3 (19)

Shelter factor

$$(20) = 1 - [0.075 \times (19)] = 0.7750 \quad (20)$$

Infiltration rate adjusted to include shelter factor

$$(21) = (18) \times (20) = 0.2814 \quad (21)$$

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |       |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |        |       |
| Effective ac    | 0.3588 | 0.3517 | 0.3447 | 0.3095 | 0.3025 | 0.2673 | 0.2673 | 0.2603 | 0.2814 | 0.3025 | 0.3166 | 0.3306 | (22b) |
|                 | 0.5644 | 0.5619 | 0.5594 | 0.5479 | 0.5458 | 0.5357 | 0.5357 | 0.5339 | 0.5396 | 0.5458 | 0.5501 | 0.5547 | (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 Semi-glazed door                           |             |                | 3.3800        | 1.0000           | 3.3800               |                   |               | (26a) |
| TER Opening Type (Uw = 1.20)                   |             |                | 16.8400       | 1.1450           | 19.2824              |                   |               | (27)  |
| Ground floor                                   |             |                | 64.8000       | 0.1300           | 8.4240               |                   |               | (28a) |
| Exposed over garage                            |             |                | 14.9000       | 0.1300           | 1.9370               |                   |               | (28b) |
| External Walls                                 | 154.0520    | 20.2200        | 133.8320      | 0.1800           | 24.0898              |                   |               | (29a) |
| Wall to garage                                 | 16.3540     |                | 16.3540       | 0.1800           | 2.9437               |                   |               | (29a) |
| Roof at ceiling                                | 64.9000     |                | 64.9000       | 0.1100           | 7.1390               |                   |               | (30)  |
| Roof at slope                                  | 17.8800     |                | 17.8800       | 0.1100           | 1.9668               |                   |               | (30)  |
| Total net area of external elements Aum(A, m2) |             |                | 332.8860      |                  |                      |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               |                  | (26)...(30) + (32) = | 69.1627           |               | (33)  |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

98.5185 (35)

List of Thermal Bridges

|                                                                           | Length  | Psi-value | Total                 |              |
|---------------------------------------------------------------------------|---------|-----------|-----------------------|--------------|
| K1 Element                                                                | 18.3000 | 0.0500    | 0.9150                |              |
| E2 Other lintels (including other steel lintels)                          | 16.9500 | 0.0500    | 0.8475                |              |
| E3 Sill                                                                   | 34.4000 | 0.0500    | 1.7200                |              |
| E4 Jamb                                                                   |         |           |                       |              |
| E7 Party floor between dwellings (in blocks of flats)                     | 0.0000  | 0.0700    | 0.0000                |              |
| E8 Balcony within a dwelling, wall insulation continuous                  | 0.0000  | 0.0000    | 0.0000                |              |
| E14 Flat roof                                                             | 0.0000  | 0.0800    | 0.0000                |              |
| E16 Corner (normal)                                                       | 22.9000 | 0.0900    | 2.0610                |              |
| E17 Corner (inverted - internal area greater than external area)          | 2.5000  | -0.0900   | -0.2250               |              |
| E18 Party wall between dwellings                                          | 0.0000  | 0.0600    | 0.0000                |              |
| E25 Staggered party wall between dwellings                                | 0.0000  | 0.0600    | 0.0000                |              |
| E5 Ground floor (normal)                                                  | 29.8700 | 0.1600    | 4.7792                |              |
| E6 Intermediate floor within a dwelling                                   | 29.8700 | 0.0000    | 0.0000                |              |
| E10 Eaves (insulation at ceiling level)                                   | 16.4300 | 0.0600    | 0.9858                |              |
| E12 Gable (insulation at ceiling level)                                   | 18.4800 | 0.0600    | 1.1088                |              |
| E21 Exposed floor (inverted)                                              | 19.9300 | 0.3200    | 6.3776                |              |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000                |              |
| P4 Party wall - Roof (insulation at ceiling level)                        | 0.0000  | 0.1200    | 0.0000                |              |
| P1 Party wall - Ground floor                                              | 0.0000  | 0.0800    | 0.0000                |              |
| P2 Party wall - Intermediate floor within a dwelling                      | 0.0000  | 0.0000    | 0.0000                |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |           | 18.5699               | (36)         |
| Point Thermal bridges                                                     |         |           | (36a) =               | 0.0000       |
| Total fabric heat loss                                                    |         |           | (33) + (36) + (36a) = | 87.7326 (37) |

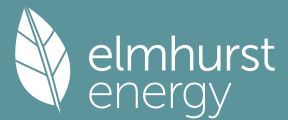
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| (38)m                     | 65.8771  | 65.5854  | 65.2994  | 63.9564  | 63.7051  | 62.5353  | 62.5353  | 62.3187  | 62.9859  | 63.7051  | 64.2134  | 64.7449  | (38) |
| Heat transfer coeff       | 153.6097 | 153.3180 | 153.0321 | 151.6890 | 151.4377 | 150.2680 | 150.2680 | 150.0513 | 150.7185 | 151.4377 | 151.9461 | 152.4775 | (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 151.6878 |      |
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| HLP                       | 1.0857   | 1.0836   | 1.0816   | 1.0721   | 1.0703   | 1.0620   | 1.0620   | 1.0605   | 1.0652   | 1.0703   | 1.0739   | 1.0777   | (40) |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.0721   |      |
| Days in mont              | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

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

|                                                                 |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------|-----------|-------------|
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |                    |          |           | 2.9199 (42) |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| 73.1764                                                         | 72.0767  | 70.4742  | 67.4082  | 65.1455  | 62.6222  | 61.1880  | 62.7783  | 64.5216  | 67.2309  | 70.3628            | 72.8961  | 72.8961   | (42a)       |
| Hot water usage for baths                                       |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| 31.5915                                                         | 31.1223  | 30.4616  | 29.2434  | 28.3312  | 27.3197  | 26.7734  | 27.4295  | 28.1438  | 29.2261  | 30.4694            | 31.4847  | 31.4847   | (42b)       |
| Hot water usage for other uses                                  |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| 44.5324                                                         | 42.9130  | 41.2936  | 39.6743  | 38.0549  | 36.4356  | 36.4356  | 38.0549  | 39.6743  | 41.2936  | 42.9130            | 44.5324  | 44.5324   | (42c)       |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |                    |          | 137.2405  | (43)        |
|                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec       |             |
| Daily hot water use                                             | 149.3003 | 146.1120 | 142.2295 | 136.3259 | 131.5317 | 126.3775 | 124.3969 | 128.2627 | 132.3397 | 137.7507           | 143.7452 | 148.9131  | (44)        |
| Energy conte                                                    | 236.4551 | 208.0616 | 218.6014 | 186.6233 | 177.0669 | 155.3959 | 150.4473 | 158.8160 | 163.1881 | 186.9264           | 204.7915 | 233.1619  | (45)        |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 2279.5355 |             |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| 35.4683                                                         | 31.2092  | 32.7902  | 27.9935  | 26.5600  | 23.3094  | 22.5671  | 23.8224  | 24.4782  | 28.0390  | 30.7187            | 34.9743  | 34.9743   | (46)        |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                    |          | 200.0000  | (47)        |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                    |          | 1.6525    | (48)        |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                    |          | 0.5400    | (49)        |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                    |          | 0.8924    | (55)        |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| 27.6637                                                         | 24.9865  | 27.6637  | 26.7713  | 27.6637  | 26.7713  | 27.6637  | 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  | 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 |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| 287.3812                                                        | 254.0593 | 269.5275 | 235.9066 | 227.9930 | 204.6792 | 201.3734 | 209.7421 | 212.4714 | 237.8524 | 254.0748           | 284.0880 | 284.0880  | (62)        |
| WWHRS                                                           | -33.4532 | -29.5863 | -30.9811 | -25.6535 | -23.9082 | -20.4584 | -19.1765 | -20.3923 | -21.1670 | -24.9536           | -28.2694 | -32.8337  | (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                                                 |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| 253.9280                                                        | 224.4730 | 238.5465 | 210.2531 | 204.0848 | 184.2208 | 182.1969 | 189.3498 | 191.3044 | 212.8988 | 225.8053           | 251.2543 | 251.2543  | (64)        |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |                    |          | 2568.3157 | (64)        |

# Full SAP Calculation Printout



|                                                                                |          |          |          |          |         |         |         |         |         |          |          |               |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|---------------|
| 12Total per year (kWh/year)                                                    |          |          |          |          |         |         |         |         |         |          |          | 2568 (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                                       | 119.3622 | 105.9787 | 113.4258 | 101.4789 | 99.6156 | 91.0958 | 90.7646 | 93.5472 | 93.6867 | 102.8939 | 107.5198 | 118.2672 (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                                                                               | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934  | 145.9934 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 174.4857  | 193.1806  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857  | 174.4857  | 180.3019  | 174.4857  | 180.3019  | 174.4857 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 311.0999  | 314.3281  | 306.1930  | 288.8744  | 267.0128  | 246.4660  | 232.7394  | 229.5112  | 237.6462  | 254.9648  | 276.8265  | 297.3733 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993   | 37.5993 (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    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 | -116.7947 (71) |
| Water heating gains (Table 5)                                                       | 160.4330  | 157.7064  | 152.4541  | 140.9429  | 133.8919  | 126.5219  | 121.9954  | 125.7355  | 130.1204  | 138.2982  | 149.3330  | 158.9613 (72)  |
| Total internal gains                                                                | 715.8166  | 735.0131  | 702.9309  | 679.9173  | 645.1885  | 620.0878  | 596.0186  | 596.5304  | 614.8666  | 637.5468  | 676.2595  | 700.6183 (73)  |

## 6. Solar gains

| [Jan]       |          |           |           |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|-----------|-----------|-----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|
| North       |          |           |           |           | 2.1600     | 10.6334                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 7.0194 (74)   |
| East        |          |           |           |           | 6.6200     | 19.6403                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 39.7354 (76)  |
| South       |          |           |           |           | 8.0600     | 46.7521                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 115.1616 (78) |
| Solar gains | 161.9163 | 279.7502  | 391.0551  | 494.8445  | 561.0812   | 559.3281                       | 538.3441  | 489.0346                          | 427.2576                           | 311.6304                     | 194.7104 | 138.0383 (83) |
| Total gains | 877.7330 | 1014.7633 | 1093.9860 | 1174.7618 | 1206.2697  | 1179.4160                      | 1134.3627 | 1085.5650                         | 1042.1242                          | 949.1772                     | 870.9698 | 838.6567 (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                                                                | 25.2071 | 25.2550 | 25.3022 | 25.5262 | 25.5686 | 25.7676 | 25.7676 | 25.8048 | 25.6906 | 25.5686 | 25.4831 | 25.3942      |
| alpha                                                              | 2.6805  | 2.6837  | 2.6868  | 2.7017  | 2.7046  | 2.7178  | 2.7178  | 2.7203  | 2.7127  | 2.7046  | 2.6989  | 2.6929       |
| util living area                                                   | 0.9621  | 0.9437  | 0.9181  | 0.8666  | 0.7838  | 0.6528  | 0.5181  | 0.5529  | 0.7299  | 0.8807  | 0.9441  | 0.9662 (86)  |
| MIT                                                                | 18.4401 | 18.7507 | 19.1905 | 19.7781 | 20.3076 | 20.7123 | 20.8898 | 20.8648 | 20.5814 | 19.8945 | 19.0731 | 18.3871 (87) |
| Th 2                                                               | 20.0126 | 20.0143 | 20.0159 | 20.0237 | 20.0252 | 20.0320 | 20.0320 | 20.0332 | 20.0293 | 20.0252 | 20.0222 | 20.0191 (88) |
| util rest of house                                                 | 0.9567  | 0.9356  | 0.9059  | 0.8453  | 0.7460  | 0.5869  | 0.4239  | 0.4606  | 0.6724  | 0.8574  | 0.9347  | 0.9613 (89)  |
| MIT 2                                                              | 17.0081 | 17.4012 | 17.9564 | 18.6918 | 19.3324 | 19.7932 | 19.9648 | 19.9462 | 19.6582 | 18.8476 | 17.8189 | 16.9448 (90) |
| Living area fraction                                               | 17.1821 | 17.5652 | 18.1064 | 18.8239 | 19.4510 | 19.9050 | 20.0773 | 20.0579 | 19.7705 | 18.9748 | 17.9713 | 17.1201 (92) |
| MIT                                                                | 17.1821 | 17.5652 | 18.1064 | 18.8239 | 19.4510 | 19.9050 | 20.0773 | 20.0579 | 19.7705 | 18.9748 | 17.9713 | 17.1201 (92) |
| Temperature adjustment                                             |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                       | 17.1821 | 17.5652 | 18.1064 | 18.8239 | 19.4510 | 19.9050 | 20.0773 | 20.0579 | 19.7705 | 18.9748 | 17.9713 | 17.1201 (93) |

## 8. Space heating requirement

|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|-----------|----------------|
| Utilisation                                                                    | 0.9337    | 0.9079    | 0.8745    | 0.8129    | 0.7200    | 0.5774   | 0.4286   | 0.4632   | 0.6548   | 0.8255        | 0.9073    | 0.9398 (94)    |
| Useful gains                                                                   | 819.5471  | 921.3084  | 956.7230  | 954.9521  | 868.5433  | 680.9865 | 486.2065 | 502.7827 | 682.3739 | 783.4995      | 790.2180  | 788.2044 (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                                                               | 1978.8209 | 1941.8086 | 1776.1522 | 1505.3400 | 1173.7895 | 797.1668 | 522.5204 | 548.8725 | 854.6441 | 1268.2652     | 1651.8587 | 1970.0295 (97) |
| Space heating kWh                                                              | 862.4997  | 685.7761  | 609.6553  | 396.2793  | 227.1032  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 360.6657      | 620.3813  | 879.2779 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |               |           | 4641.6385      |
| 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                                                              | 862.4997  | 685.7761  | 609.6553  | 396.2793  | 227.1032  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 360.6657      | 620.3813  | 879.2779 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |               |           | 4641.6385      |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          | (98c) / (4) = |           | 32.8054 (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 %)                      |          |          |          |          |          |        |        |        |        |          |          | 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                                             | 862.4997 | 685.7761 | 609.6553 | 396.2793 | 227.1032 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 360.6657 | 620.3813 | 879.2779 (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)                              | 934.4526 | 742.9861 | 660.5150 | 429.3383 | 246.0490 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 390.7537 | 672.1357 | 952.6304 (211) |
| Space heating efficiency (main heating system 2)                      |          |          |          |          |          |        |        |        |        |          |          |                |

# Full SAP Calculation Printout



|                                                                                                              |          |          |           |           |           |           |           |           |           |           |          |            |        |
|--------------------------------------------------------------------------------------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|------------|--------|
| 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     | (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     | (213)  |
|                                                                                                              | 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                                                                                    | 253.9280 | 224.4730 | 238.5465  | 210.2531  | 204.0848  | 184.2208  | 182.1969  | 189.3498  | 191.3044  | 212.8988  | 225.8053 | 251.2543   | (64)   |
| Efficiency of water heater (217)m                                                                            | 86.5791  | 86.3971  | 86.0700   | 85.4589   | 84.3000   | 79.8000   | 79.8000   | 79.8000   | 79.8000   | 85.2319   | 86.2056  | 79.8000    | (216)  |
| Fuel for water heating, kWh/month                                                                            | 293.2902 | 259.8156 | 277.1541  | 246.0282  | 242.0934  | 230.8531  | 228.3169  | 237.2805  | 239.7298  | 249.7876  | 261.9382 | 290.0361   | (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                                                                                                 | 7.3041   | 6.5973   | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041    | 7.0685   | 7.3041     | (231)  |
| Lighting                                                                                                     | 36.2547  | 29.0849  | 26.1877   | 19.1862   | 14.8200   | 12.1081   | 13.5193   | 17.5729   | 22.8254   | 29.9482   | 33.8264  | 37.2623    | (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)m                                        | -58.2626 | -80.9337 | -114.5871 | -126.7565 | -134.8474 | -125.0970 | -123.4577 | -117.4111 | -106.5203 | -91.4992  | -63.5889 | -50.5062   | (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                                        | -36.6173 | -76.5980 | -151.5070 | -226.5350 | -298.6222 | -299.8182 | -296.3742 | -251.4164 | -184.8584 | -109.2950 | -48.7974 | -28.9956   | (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                                                                           |          |          |           |           |           |           |           |           |           |           |          | 5028.8608  | (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                                                                                      |          |          |           |           |           |           |           |           |           |           |          | 3056.3238  | (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)                                                          |          |          |           |           |           |           |           |           |           |           |          | 292.5961   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                                |          |          |           |           |           |           |           |           |           |           |          |            |        |
| PV generation                                                                                                |          |          |           |           |           |           |           |           |           |           |          | -3202.9025 | (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                                                                          |          |          |           |           |           |           |           |           |           |           |          | 5260.8782  | (238)  |

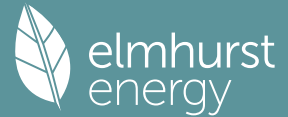
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |       |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|-------|
| Space heating - main system 1                 | 5028.8608          | 0.2100                        | 1056.0608                | (261) |
| Total CO2 associated with community systems   |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                    | 3056.3238          | 0.2100                        | 641.8280                 | (264) |
| Space and water heating                       |                    |                               | 1697.8888                | (265) |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293                  | (267) |
| Energy for lighting                           | 292.5961           | 0.1443                        | 42.2307                  | (268) |
| Energy saving/generation technologies         |                    |                               |                          |       |
| PV Unit electricity used in dwelling          | -1193.4676         | 0.1349                        | -161.0433                |       |
| PV Unit electricity exported                  | -2009.4349         | 0.1260                        | -253.2314                |       |
| Total                                         |                    |                               | -414.2747                | (269) |
| Total CO2, kg/year                            |                    |                               | 1337.7739                | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 9.4500                   | (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               | 5028.8608          | 1.1300                              | 5682.6127                  | (275) |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473) |
| Water heating (other fuel)                  | 3056.3238          | 1.1300                              | 3453.6459                  | (278) |
| Space and water heating                     |                    |                                     | 9136.2586                  | (279) |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008                   | (281) |
| Energy for lighting                         | 292.5961           | 1.5338                              | 448.7937                   | (282) |
| Energy saving/generation technologies       |                    |                                     |                            |       |
| PV Unit electricity used in dwelling        | -1193.4676         | 1.4987                              | -1788.6802                 |       |
| PV Unit electricity exported                | -2009.4349         | 0.4626                              | -929.5434                  |       |
| Total                                       |                    |                                     | -2718.2236                 | (283) |
| Total Primary energy kWh/year               |                    |                                     | 6996.9295                  | (286) |
| Target Primary Energy Rate (TPER)           |                    |                                     | 49.4500                    | (287) |

# Full SAP Calculation Printout



|                                    |                        |               |       |               |                |            |  |
|------------------------------------|------------------------|---------------|-------|---------------|----------------|------------|--|
| Property Reference                 | HT6 SD                 |               |       |               | Issued on Date | 22/11/2024 |  |
| Assessment Reference               | Fabric                 |               |       | Prop Type Ref |                |            |  |
| Property                           |                        |               |       |               |                |            |  |
|                                    |                        |               |       |               |                |            |  |
| SAP Rating                         | 85 B                   | DER           | 11.77 | TER           | 11.62          |            |  |
| Environmental                      | 89 B                   | % DER < TER   |       |               |                | -1.29      |  |
| CO <sub>2</sub> Emissions (t/year) | 1.08                   | DFEE          | 38.75 | TFEE          | 43.79          |            |  |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |               |                | 11.50      |  |
| % DPER < TPER                      | -11.69                 | DPER          | 68.10 | TPER          | 60.97          |            |  |
|                                    |                        |               |       |               |                |            |  |
| Assessor Details                   | Mr. Michael Woodbridge |               |       |               | Assessor ID    | M818-0001  |  |
| Client                             |                        |               |       |               |                |            |  |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) |   | Storey height<br>(m)            |   | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---|---------------------------------|---|-----------------------------|
| Ground floor                                           | 45.0000 (1b)              | x | 2.3100 (2b)                     | = | 103.9500 (1b) - (3b)        |
| First floor                                            | 60.3500 (1c)              | x | 2.6200 (2c)                     | = | 158.1170 (1c) - (3c)        |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.3500                  |   |                                 |   | (4)                         |
| Dwelling volume                                        |                           |   | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 262.0670 (5)                |

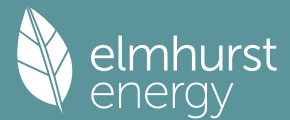
## 2. Ventilation rate

|                                                                                                         | 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                                                                                    | 4.0000 (17)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate                                                                                       | 0.2000 (18)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Number of sides sheltered                                                                               | 2 (19)                                                                          |            |            |            |            |            |            |            |            |            |            |                 |
| Shelter factor                                                                                          | (20) = 1 - [0.075 x (19)] = 0.8500 (20)                                         |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate adjusted to include shelter factor                                                    | (21) = (18) x (20) = 0.1700 (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                                                                                         | 0.2167                                                                          | 0.2125     | 0.2083     | 0.1870     | 0.1827     | 0.1615     | 0.1615     | 0.1573     | 0.1700     | 0.1827     | 0.1913     | 0.1998 (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) =            |                                                                                 |            |            |            |            |            |            |            |            |            |            | 81.9000 (23c)   |
| Effective ac                                                                                            | 0.3072                                                                          | 0.3030     | 0.2987     | 0.2775     | 0.2732     | 0.2520     | 0.2520     | 0.2477     | 0.2605     | 0.2732     | 0.2817     | 0.2903 (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    |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------|
| External Doors                                              |                         |                            | 2.1000                    | 1.0000                        | 2.1000       |                                | (26)             |
| Glazing (Uw = 0.80)                                         |                         |                            | 14.2800                   | 0.7752                        | 11.0698      |                                | (27)             |
| Ground Floor                                                |                         |                            | 45.0000                   | 0.1200                        | 5.4000       | 75.0000                        | 3375.0000 (28a)  |
| Exposed Floor                                               |                         |                            | 15.3500                   | 0.1200                        | 1.8420       | 20.0000                        | 307.0000 (28b)   |
| External Wall                                               | 113.7400                | 16.3800                    | 97.3600                   | 0.1500                        | 14.6040      | 150.0000                       | 14603.9997 (29a) |
| Split Level GF                                              | 7.2100                  |                            | 7.2100                    | 0.1500                        | 1.0815       | 60.0000                        | 432.6000 (29a)   |
| Split Level TF                                              | 7.2100                  |                            | 7.2100                    | 0.1500                        | 1.0815       | 9.0000                         | 64.8900 (29a)    |
| External Roof                                               | 60.3500                 |                            | 60.3500                   | 0.1100                        | 6.6385       | 9.0000                         | 543.1500 (30)    |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 248.8600                  |                               |              |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 43.8173      |                                | (33)             |
| Party Wall                                                  |                         |                            | 42.6000                   | 0.0000                        | 0.0000       | 45.0000                        | 1916.9999 (32)   |
| Internal Wall Stud                                          |                         |                            | 96.4800                   |                               |              | 9.0000                         | 868.3200 (32c)   |
| Internal Wall Block                                         |                         |                            | 94.1000                   |                               |              | 75.0000                        | 7057.4999 (32c)  |
| Internal Floor 1                                            |                         |                            | 45.0000                   |                               |              | 18.0000                        | 810.0000 (32d)   |

# Full SAP Calculation Printout



Internal Ceiling 1 45.0000 9.0000 405.0000 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30384.4595 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 288.4144 (35)

| List of Thermal Bridges                                                   | Length  | Psi-value             | Total          |
|---------------------------------------------------------------------------|---------|-----------------------|----------------|
| K1 Element                                                                |         |                       |                |
| E2 Other lintels (including other steel lintels)                          | 13.2140 | 0.0500                | 0.6607         |
| E3 Sill                                                                   | 10.7140 | 0.0500                | 0.5357         |
| E4 Jamb                                                                   | 35.9700 | 0.0500                | 1.7985         |
| E5 Ground floor (normal)                                                  | 20.3600 | 0.1600                | 3.2576         |
| E6 Intermediate floor within a dwelling                                   | 20.3600 | 0.0000                | 0.0000         |
| E10 Eaves (insulation at ceiling level)                                   | 18.3000 | 0.0600                | 1.0980         |
| E12 Gable (insulation at ceiling level)                                   | 10.3900 | 0.0600                | 0.6234         |
| E16 Corner (normal)                                                       | 17.1000 | 0.0900                | 1.5390         |
| E17 Corner (inverted - internal area greater than external area)          | 7.2400  | -0.0900               | -0.6516        |
| E19 Ground floor (inverted)                                               | 5.0000  | 0.0700                | 0.3500         |
| E22 Basement floor                                                        | 5.0000  | 0.0700                | 0.3500         |
| E24 Eaves (insulation at ceiling level - inverted)                        | 10.0000 | 0.1500                | 1.5000         |
| E18 Party wall between dwellings                                          | 9.8600  | 0.0600                | 0.5916         |
| P1 Party wall - Ground floor                                              | 8.6400  | 0.0800                | 0.6912         |
| P2 Party wall - Intermediate floor within a dwelling                      | 8.6400  | 0.0000                | 0.0000         |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000                | 0.0000         |
| P4 Party wall - Roof (insulation at ceiling level)                        | 8.6400  | 0.1200                | 1.0368         |
| E20 Exposed floor (normal)                                                | 11.7000 | 0.3200                | 3.7440         |
| E21 Exposed floor (inverted)                                              | 5.0000  | 0.3200                | 1.6000         |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |                       | 18.7249 (36)   |
| Point Thermal bridges                                                     |         |                       | 0.0000 (36a) = |
| Total fabric heat loss                                                    |         | (33) + (36) + (36a) = | 62.5422 (37)   |

|                                                                     |                |                |                |                |                |                |                |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                |                |                |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>26.5716 | Feb<br>26.2041 | Mar<br>25.8365 | Apr<br>23.9988 | May<br>23.6312 | Jun<br>21.7935 | Jul<br>21.7935 | Aug<br>21.4259 | Sep<br>22.5286 | Oct<br>23.6312 | Nov<br>24.3663 | Dec<br>25.1014 (38) |
| Heat transfer coeff                                                 | 89.1138        | 88.7462        | 88.3787        | 86.5410        | 86.1734        | 84.3357        | 84.3357        | 83.9681        | 85.0708        | 86.1734        | 86.9085        | 87.6436 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                |                |                |                |                |                |                |                | 86.4491             |
| HLP                                                                 | Jan<br>0.8459  | Feb<br>0.8424  | Mar<br>0.8389  | Apr<br>0.8215  | May<br>0.8180  | Jun<br>0.8005  | Jul<br>0.8005  | Aug<br>0.7970  | Sep<br>0.8075  | Oct<br>0.8180  | Nov<br>0.8250  | Dec<br>0.8319 (40)  |
| HLP (average)                                                       |                |                |                |                |                |                |                |                |                |                |                | 0.8206              |
| Days in mont                                                        | 31             | 28             | 31             | 30             | 31             | 30             | 31             | 31             | 30             | 31             | 30             | 31                  |

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

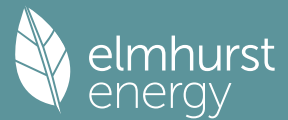
|                                                                                |          |          |          |          |          |          |          |          |          |                    |          |                |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------|----------------|-------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |                    |          |                | 2.7838 (42) |
| Hot water usage for mixer showers                                              |          |          |          |          |          |          |          |          |          |                    |          |                |             |
| 70.8957                                                                        | 69.8302  | 68.2777  | 65.3072  | 63.1151  | 60.6704  | 59.2809  | 60.8216  | 62.5106  | 65.1354  | 68.1697            | 70.6240  | (42a)          |             |
| Hot water usage for baths                                                      |          |          |          |          |          |          |          |          |          |                    |          |                |             |
| 30.6107                                                                        | 30.1561  | 29.5159  | 28.3355  | 27.4516  | 26.4716  | 25.9422  | 26.5779  | 27.2701  | 28.3188  | 29.5235            | 30.5072  | (42b)          |             |
| Hot water usage for other uses                                                 |          |          |          |          |          |          |          |          |          |                    |          |                |             |
| 43.1393                                                                        | 41.5706  | 40.0019  | 38.4332  | 36.8645  | 35.2958  | 35.2958  | 36.8645  | 38.4332  | 40.0019  | 41.5706            | 43.1393  | (42c)          |             |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |                    |          | 132.9619 (43)  |             |
|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec            |             |
| Daily hot water use                                                            | 144.6456 | 141.5569 | 137.7955 | 132.0759 | 127.4312 | 122.4378 | 120.5188 | 124.2640 | 128.2139 | 133.4561           | 139.2638 | 144.2705 (44)  |             |
| Energy content                                                                 | 229.0833 | 201.5751 | 211.7865 | 180.8053 | 171.5469 | 150.5515 | 145.7571 | 153.8648 | 158.1005 | 181.0987           | 198.4068 | 225.8928 (45)  |             |
| Energy content (annual)                                                        |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 2208.4693      |             |
| Distribution loss (46)m = 0.15 x (45)m                                         |          |          |          |          |          |          |          |          |          |                    |          |                |             |
| 34.3625                                                                        | 30.2363  | 31.7680  | 27.1208  | 25.7320  | 22.5827  | 21.8636  | 23.0797  | 23.7151  | 27.1648  | 29.7610            | 33.8839  | (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                                                                     | 50.9589  | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589  | 49.3151  | 50.9589            | 49.3151  | 50.9589 (61)   |             |
| Total heat required for water heating calculated for each month                |          |          |          |          |          |          |          |          |          |                    |          |                |             |
| 280.0422                                                                       | 247.6025 | 262.7454 | 230.1204 | 222.5058 | 199.8666 | 196.7160 | 204.8237 | 207.4156 | 232.0576 | 247.7219           | 276.8517 | (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                                                                | 280.0422 | 247.6025 | 262.7454 | 230.1204 | 222.5058 | 199.8666 | 196.7160 | 204.8237 | 207.4156 | 232.0576           | 247.7219 | 276.8517 (64)  |             |
|                                                                                |          |          |          |          |          |          |          |          |          |                    |          | 2808.4693 (64) |             |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          |                    |          | 2808 (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)   |             |
|                                                                                |          |          |          |          |          |          |          |          |          |                    |          | 0.0000 (64a)   |             |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |                    |          |                |             |
| Heat gains from water heating, kWh/month                                       | 88.9099  | 78.5306  | 83.1587  | 72.4465  | 69.7791  | 62.3871  | 61.2040  | 63.8998  | 64.8972  | 72.9550            | 78.2990  | 87.8491 (65)   |             |

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

|                                                                                     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
|-------------------------------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|
| Metabolic gains (Table 5), Watts                                                    |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
| (66)m                                                                               | Jan<br>139.1920 | Feb<br>139.1920 | Mar<br>139.1920 | Apr<br>139.1920 | May<br>139.1920 | Jun<br>139.1920 | Jul<br>139.1920 | Aug<br>139.1920 | Sep<br>139.1920 | Oct<br>139.1920 | Nov<br>139.1920 | Dec<br>139.1920 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
| 148.5750                                                                            | 164.4938        | 148.5750        | 153.5275        | 148.5750        | 153.5275        | 148.5750        | 148.5750        | 153.5275        | 148.5750        | 153.5275        | 148.5750        | 148.5750 (67)        |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
| 264.6980                                                                            | 267.4448        | 260.5231        | 245.7876        | 227.1868        | 209.7046        | 198.0254        | 195.2787        | 202.2003        | 216.9358        | 235.5367        | 253.0189        | 253.0189 (68)        |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
| 36.9192                                                                             | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192         | 36.9192 (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          | 3.0000 (70)          |
| Losses e.g. evaporation (negative values) (Table 5)                                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
| -111.3536                                                                           | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536       | -111.3536 (71)       |
| Water heating gains (Table 5)                                                       |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
| 119.5026                                                                            | 116.8610        | 111.7725        | 100.6202        | 93.7891         | 86.6488         | 82.2634         | 85.8868         | 90.1350         | 98.0578         | 108.7487        | 118.0767        | 118.0767 (72)        |
| Total internal gains                                                                | 600.5332        | 616.5571        | 588.6282        | 567.6929        | 537.3084        | 514.6385        | 493.6214        | 494.4981        | 510.6204        | 531.3262        | 565.5704        | 587.4282 (73)        |

## 6. Solar gains

# Full SAP Calculation Printout



| [Jan] |  |  |  |  | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-------|--|--|--|--|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| North |  |  |  |  | 1.7800     | 10.6334                        | 0.5000                            | 0.7000                             | 0.7700                       | 4.5908 (74)  |
| East  |  |  |  |  | 4.1000     | 19.6403                        | 0.5000                            | 0.7000                             | 0.7700                       | 19.5314 (76) |
| South |  |  |  |  | 0.9600     | 46.7521                        | 0.5000                            | 0.7000                             | 0.7700                       | 10.8861 (78) |
| West  |  |  |  |  | 7.4400     | 19.6403                        | 0.5000                            | 0.7000                             | 0.7700                       | 35.4423 (80) |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 70.4506  | 134.1421 | 214.7218 | 307.9085 | 375.5547 | 384.3184 | 365.8950 | 315.0037 | 247.6265 | 157.2788 | 87.1128  | 58.4414 (83)  |
| Total gains | 670.9838 | 750.6992 | 803.3500 | 875.6014 | 912.8632 | 898.9569 | 859.5164 | 809.5017 | 758.2470 | 688.6050 | 652.6833 | 645.8696 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |          |          |          |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|----------|----------|----------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |          |          |          |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |          |          |          |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun      | Jul      | Aug      | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 94.7118 | 95.1041 | 95.4996 | 97.5276 | 97.9435 | 100.0778 | 100.0778 | 100.5159 | 99.2130                   | 97.9435 | 97.1151 | 96.3006      |
| alpha                                                                       | 7.3141  | 7.3403  | 7.3666  | 7.5018  | 7.5296  | 7.6719   | 7.6719   | 7.7011   | 7.6142                    | 7.5296  | 7.4743  | 7.4200       |
| util living area                                                            | 0.9984  | 0.9958  | 0.9878  | 0.9452  | 0.8180  | 0.5956   | 0.4313   | 0.4763   | 0.7462                    | 0.9644  | 0.9954  | 0.9988 (86)  |
| MIT                                                                         | 20.2190 | 20.3493 | 20.5337 | 20.7896 | 20.9475 | 20.9958  | 20.9997  | 20.9993  | 20.9796                   | 20.7774 | 20.4651 | 20.2084 (87) |
| Th 2                                                                        | 20.2137 | 20.2167 | 20.2197 | 20.2348 | 20.2378 | 20.2529  | 20.2529  | 20.2559  | 20.2468                   | 20.2378 | 20.2318 | 20.2257 (88) |
| util rest of house                                                          | 0.9978  | 0.9942  | 0.9832  | 0.9260  | 0.7693  | 0.5284   | 0.3583   | 0.3998   | 0.6765                    | 0.9478  | 0.9934  | 0.9983 (89)  |
| MIT 2                                                                       | 19.2968 | 19.4656 | 19.7014 | 20.0256 | 20.1966 | 20.2507  | 20.2528  | 20.2557  | 20.2345                   | 20.0189 | 19.6259 | 19.2930 (90) |
| Living area fraction                                                        |         |         |         |         |         |          |          |          | fLA = Living area / (4) = |         |         | 0.1729 (91)  |
| MIT                                                                         | 19.4562 | 19.6184 | 19.8453 | 20.1577 | 20.3264 | 20.3795  | 20.3819  | 20.3842  | 20.3633                   | 20.1500 | 19.7710 | 19.4512 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |          |          |          |                           |         |         | -0.1500      |
| adjusted MIT                                                                | 19.3062 | 19.4684 | 19.6953 | 20.0077 | 20.1764 | 20.2295  | 20.2319  | 20.2342  | 20.2133                   | 20.0000 | 19.6210 | 19.3012 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |          |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9968    | 0.9922    | 0.9791    | 0.9192   | 0.7651   | 0.5263   | 0.3563   | 0.3975   | 0.6732   | 0.9411        | 0.9911    | 0.9975 (94)    |
| Useful gains                                                                   | 668.8214  | 744.8142  | 786.5576  | 804.8785 | 698.4173 | 473.0910 | 306.2255 | 321.7935 | 510.4364 | 648.0722      | 646.8830  | 644.2535 (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                                                               | 1337.2629 | 1292.8868 | 1166.1842 | 961.2678 | 730.4420 | 474.7697 | 306.2974 | 321.9535 | 520.0638 | 810.0281      | 1088.1789 | 1323.5254 (97) |
| Space heating kWh                                                              | 497.3204  | 368.3048  | 282.4422  | 112.6003 | 23.8264  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 120.4952      | 317.7330  | 505.3783 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |          |          |          |          |          |          |               |           | 2228.1005      |
| 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                                                              | 497.3204  | 368.3048  | 282.4422  | 112.6003 | 23.8264  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 120.4952      | 317.7330  | 505.3783 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |          |          |          |          |          |          |               |           | 2228.1005      |
| Space heating per m2                                                           |           |           |           |          |          |          |          |          |          | (98c) / (4) = |           | 21.1495 (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 %)                                                             |          |          |          |          |          |          |          |          |          |          |          | 92.3000 (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                                                                                    | 497.3204 | 368.3048 | 282.4422 | 112.6003 | 23.8264  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 120.4952 | 317.7330 | 505.3783 (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)                                                                     | 538.8087 | 399.0301 | 306.0045 | 121.9938 | 25.8141  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 130.5474 | 344.2395 | 547.5387 (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                                                                                    | 280.0422 | 247.6025 | 262.7454 | 230.1204 | 222.5058 | 199.8666 | 196.7160 | 204.8237 | 207.4156 | 232.0576 | 247.7219 | 276.8517 (64)  |
| Efficiency of water heater (217)m                                                                            | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000 (216)  |
| Fuel for water heating, kWh/month                                                                            | 303.4044 | 268.2584 | 284.6646 | 249.3178 | 241.0680 | 216.5402 | 213.1267 | 221.9108 | 224.7190 | 251.4167 | 268.3877 | 299.9476 (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                                                                                                 | 29.0277  | 26.2185  | 29.0277  | 28.0913  | 29.0277  | 28.0913  | 29.0277  | 29.0277  | 28.0913  | 29.0277  | 28.0913  | 29.0277 (231)  |
| Lighting                                                                                                     | 39.6650  | 31.8207  | 28.6510  | 20.9910  | 16.2140  | 13.2470  | 14.7910  | 19.2259  | 24.9725  | 32.7653  | 37.0083  | 40.7674 (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)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 (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                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (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)         |          |          |          |          |          |          |          |          |          |          |          |                |

# Full SAP Calculation Printout



|                                                                            |        |        |        |        |        |        |        |        |        |        |        |           |        |
|----------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| (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                                         |        |        |        |        |        |        |        |        |        |        |        | 2413.9768 | (211)  |
| Space heating fuel - main system 2                                         |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (213)  |
| Space heating fuel - secondary                                             |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (215)  |
| Efficiency of water heater                                                 |        |        |        |        |        |        |        |        |        |        |        | 92.3000   |        |
| Water heating fuel used                                                    |        |        |        |        |        |        |        |        |        |        |        | 3042.7619 | (219)  |
| Space cooling fuel                                                         |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (221)  |
| Electricity for pumps and fans:                                            |        |        |        |        |        |        |        |        |        |        |        |           |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.6000, SFP = 0.8000) |        |        |        |        |        |        |        |        |        |        |        |           |        |
| mechanical ventilation fans (SFP = 0.8000)                                 |        |        |        |        |        |        |        |        |        |        |        | 255.7774  | (230a) |
| central heating pump                                                       |        |        |        |        |        |        |        |        |        |        |        | 41.0000   | (230c) |
| main heating flue fan                                                      |        |        |        |        |        |        |        |        |        |        |        | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                                  |        |        |        |        |        |        |        |        |        |        |        | 341.7774  | (231)  |
| Electricity for lighting (calculated in Appendix L)                        |        |        |        |        |        |        |        |        |        |        |        | 320.1190  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)              |        |        |        |        |        |        |        |        |        |        |        |           |        |
| PV generation                                                              |        |        |        |        |        |        |        |        |        |        |        | 0.0000    | (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                                        |        |        |        |        |        |        |        |        |        |        |        | 6118.6350 | (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                   | 2413.9768          | 0.2100                        | 506.9351                 | (261) |
| Total CO2 associated with community systems     |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                      | 3042.7619          | 0.2100                        | 638.9800                 | (264) |
| Space and water heating                         |                    |                               | 1145.9151                | (265) |
| Pumps, fans and electric keep-hot               | 341.7774           | 0.1387                        | 47.4087                  | (267) |
| Energy for lighting                             | 320.1190           | 0.1443                        | 46.2031                  | (268) |
| Total CO2, kg/year                              |                    |                               | 1239.5269                | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 11.7700                  | (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               | 2413.9768          | 1.1300                              | 2727.7937                  | (275) |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473) |
| Water heating (other fuel)                  | 3042.7619          | 1.1300                              | 3438.3210                  | (278) |
| Space and water heating                     |                    |                                     | 6166.1147                  | (279) |
| Pumps, fans and electric keep-hot           | 341.7774           | 1.5128                              | 517.0408                   | (281) |
| Energy for lighting                         | 320.1190           | 1.5338                              | 491.0091                   | (282) |
| Total Primary energy kWh/year               |                    |                                     | 7174.1647                  | (286) |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 68.1000                    | (287) |

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

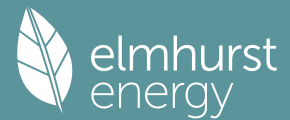
### 1. Overall dwelling characteristics

|                                                        | Area<br>(m2) | Storey height<br>(m)            | Volume<br>(m3)         |
|--------------------------------------------------------|--------------|---------------------------------|------------------------|
| Ground floor                                           | 45.0000 (1b) | x 2.3100 (2b)                   | = 103.9500 (1b) - (3b) |
| First floor                                            | 60.3500 (1c) | x 2.6200 (2c)                   | = 158.1170 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.3500     |                                 | (4)                    |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 262.0670 (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                                                                | 4 * 10 =                    | 40.0000 (7a) |
| Number of passive vents                                                                            | 0 * 10 =                    | 0.0000 (7b)  |
| Number of flueless gas fires                                                                       | 0 * 40 =                    | 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) =             | 0.1526 (8)   |
| Pressure test                                                                                      | Yes                         |              |
| Pressure Test Method                                                                               | Blower Door                 |              |
| Measured/design AP50                                                                               | 5.0000                      | (17)         |
| Infiltration rate                                                                                  | 0.4026                      | (18)         |
| Number of sides sheltered                                                                          | 2                           | (19)         |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)  |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) =        | 0.3422 (21)  |

# Full SAP Calculation Printout



|                 |        |        |        |        |        |        |        |        |        |        |        |        |       |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Wind speed      | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |       |
| Wind factor     | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22)  |
| Adj infilt rate | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Effective ac    | 0.4364 | 0.4278 | 0.4192 | 0.3765 | 0.3679 | 0.3251 | 0.3251 | 0.3166 | 0.3422 | 0.3679 | 0.3850 | 0.4021 | (22b) |
|                 | 0.5952 | 0.5915 | 0.5879 | 0.5709 | 0.5677 | 0.5529 | 0.5529 | 0.5501 | 0.5586 | 0.5677 | 0.5741 | 0.5809 | (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                                |             |                | 2.1000        | 1.0000           | 2.1000               |                   |               | (26)  |
| TER Opening Type (Uw = 1.20)                   |             |                | 14.2800       | 1.1450           | 16.3511              |                   |               | (27)  |
| Ground Floor                                   |             |                | 45.0000       | 0.1300           | 5.8500               |                   |               | (28a) |
| Exposed Floor                                  |             |                | 15.3500       | 0.1300           | 1.9955               |                   |               | (28b) |
| External Wall                                  | 113.7400    | 16.3800        | 97.3600       | 0.1800           | 17.5248              |                   |               | (29a) |
| Split Level GF                                 | 7.2100      |                | 7.2100        | 0.1800           | 1.2978               |                   |               | (29a) |
| Split Level TF                                 | 7.2100      |                | 7.2100        | 0.1800           | 1.2978               |                   |               | (29a) |
| External Roof                                  | 60.3500     |                | 60.3500       | 0.1100           | 6.6385               |                   |               | (30)  |
| Total net area of external elements Aum(A, m2) |             |                | 248.8600      |                  |                      |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               |                  | (26)...(30) + (32) = | 53.0555           |               | (33)  |
| Party Wall                                     |             |                | 42.6000       | 0.0000           | 0.0000               |                   |               | (32)  |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

288.4144 (35)

List of Thermal Bridges

| K1 Element                                                                | Length  | Psi-value | Total   |  |
|---------------------------------------------------------------------------|---------|-----------|---------|--|
| E2 Other lintels (including other steel lintels)                          | 13.2140 | 0.0500    | 0.6607  |  |
| E3 Sill                                                                   | 10.7140 | 0.0500    | 0.5357  |  |
| E4 Jamb                                                                   | 35.9700 | 0.0500    | 1.7985  |  |
| E5 Ground floor (normal)                                                  | 20.3600 | 0.1600    | 3.2576  |  |
| E6 Intermediate floor within a dwelling                                   | 20.3600 | 0.0000    | 0.0000  |  |
| E10 Eaves (insulation at ceiling level)                                   | 18.3000 | 0.0600    | 1.0980  |  |
| E12 Gable (insulation at ceiling level)                                   | 10.3900 | 0.0600    | 0.6234  |  |
| E16 Corner (normal)                                                       | 17.1000 | 0.0900    | 1.5390  |  |
| E17 Corner (inverted - internal area greater than external area)          | 7.2400  | -0.0900   | -0.6516 |  |
| E19 Ground floor (inverted)                                               | 5.0000  | 0.0700    | 0.3500  |  |
| E22 Basement floor                                                        | 5.0000  | 0.0700    | 0.3500  |  |
| E24 Eaves (insulation at ceiling level - inverted)                        | 10.0000 | 0.2400    | 2.4000  |  |
| E18 Party wall between dwellings                                          | 9.8600  | 0.0600    | 0.5916  |  |
| P1 Party wall - Ground floor                                              | 8.6400  | 0.0800    | 0.6912  |  |
| P2 Party wall - Intermediate floor within a dwelling                      | 8.6400  | 0.0000    | 0.0000  |  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000  |  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 8.6400  | 0.1200    | 1.0368  |  |
| E20 Exposed floor (normal)                                                | 11.7000 | 0.3200    | 3.7440  |  |
| E21 Exposed floor (inverted)                                              | 5.0000  | 0.3200    | 1.6000  |  |

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

19.6249 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 72.6804 (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       | 51.4743  | 51.1546  | 50.8412  | 49.3693  | 49.0939  | 47.8119  | 47.8119  | 47.5745  | 48.3057  | 49.0939  | 49.6510  | 50.2335  | (38) |
| Average = Sum(39)m / 12 = | 124.1548 | 123.8351 | 123.5217 | 122.0498 | 121.7744 | 120.4924 | 120.4924 | 120.2550 | 120.9862 | 121.7744 | 122.3315 | 122.9139 | (39) |
|                           |          |          |          |          |          |          |          |          |          |          |          | 122.0484 |      |

|               |        |        |        |        |        |        |        |        |        |        |        |        |      |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
| HLP (average) | 1.1785 | 1.1755 | 1.1725 | 1.1585 | 1.1559 | 1.1437 | 1.1437 | 1.1415 | 1.1484 | 1.1559 | 1.1612 | 1.1667 | (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                        |         |         |         |         |         |         |         |         |         |         |         |       | 2.7838 (42)   |
| Hot water usage for mixer showers        |         |         |         |         |         |         |         |         |         |         |         |       |               |
| 70.8957                                  | 69.8302 | 68.2777 | 65.3072 | 63.1151 | 60.6704 | 59.2809 | 60.8216 | 62.5106 | 65.1354 | 68.1697 | 70.6240 | (42a) |               |
| Hot water usage for baths                |         |         |         |         |         |         |         |         |         |         |         |       |               |
| 30.6107                                  | 30.1561 | 29.5159 | 28.3355 | 27.4516 | 26.4716 | 25.9422 | 26.5779 | 27.2701 | 28.3188 | 29.5235 | 30.5072 | (42b) |               |
| Hot water usage for other uses           |         |         |         |         |         |         |         |         |         |         |         |       |               |
| 43.1393                                  | 41.5706 | 40.0019 | 38.4332 | 36.8645 | 35.2958 | 35.2958 | 36.8645 | 38.4332 | 40.0019 | 41.5706 | 43.1393 | (42c) |               |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |         |       | 132.9619 (43) |

|                                        | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct              | Nov      | Dec       |      |
|----------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------------|----------|-----------|------|
| Daily hot water use                    | 144.6456 | 141.5569 | 137.7955 | 132.0759 | 127.4312 | 122.4378 | 120.5188 | 124.2640 | 128.2139 | 133.4561         | 139.2638 | 144.2705  | (44) |
| Energy conte                           | 229.0833 | 201.5751 | 211.7865 | 180.8053 | 171.5469 | 150.5515 | 145.7571 | 153.8648 | 158.1005 | 181.0987         | 198.4068 | 225.8928  | (45) |
| Energy content (annual)                |          |          |          |          |          |          |          |          |          | Total = Sum(45)m |          | 2208.4693 |      |
| Distribution loss (46)m = 0.15 x (45)m |          |          |          |          |          |          |          |          |          |                  |          |           |      |
|                                        | 34.3625  | 30.2363  | 31.7680  | 27.1208  | 25.7320  | 22.5827  | 21.8636  | 23.0797  | 23.7151  | 27.1648          | 29.7610  | 33.8839   | (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                                                      | 50.9589  | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | (61)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |          |       |
|                                                                 | 280.0422 | 247.6025 | 262.7454 | 230.1204 | 222.5058 | 199.8666 | 196.7160 | 204.8237 | 207.4156 | 232.0576 | 247.7219 | 276.8517 | (62)  |
| WWHRS                                                           | -32.4105 | -28.6641 | -30.0154 | -24.8540 | -23.1630 | -19.8207 | -18.5788 | -19.7567 | -20.5073 | -24.1759 | -27.3883 | -31.8103 | (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

|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| output from wh              | 247.6317 | 218.9384 | 232.7300 | 205.2664 | 199.3428 | 180.0458 | 178.1372 | 185.0670 | 186.9083 | 207.8817 | 220.3336 | 245.0413 (64) |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
| 12Total per year (kWh/year) |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |
|                             |          |          |          |          |          |          |          |          |          |          |          |               |

12Total per year (kWh/year)

Total per year (kWh/year) = Sum(64a)m = 2507.3242 (64)

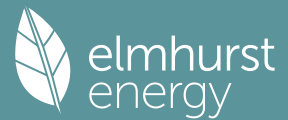
Electric shower(s)

|        |        |        |        |        |        |        |        |        |        |        |        |        |       |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 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) |
|        |        |        |        |        |        |        |        |        |        |        |        |        |       |
|        |        |        |        |        |        |        |        |        |        |        |        |        |       |

Heat gains from water heating, kWh/month

88.9099 78.5306 83.1587 72.4465 69.7791 62.3871 61.2040 63.8998 64.8972 72.9550 78.2990 87.8491 (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                                                                               | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 144.2474  | 159.7025  | 144.2474  | 149.0557  | 144.2474  | 149.0557  | 144.2474  | 144.2474  | 149.0557  | 144.2474  | 149.0557  | 144.2474 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 264.6980  | 267.4448  | 260.5231  | 245.7876  | 227.1868  | 209.7046  | 198.0254  | 195.2787  | 202.2003  | 216.9358  | 235.5367  | 253.0189 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192 (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    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 (71) |
| Water heating gains (Table 5)                                                       | 119.5026  | 116.8610  | 111.7725  | 100.6202  | 93.7891   | 86.6488   | 82.2634   | 85.8868   | 90.1350   | 98.0578   | 108.7487  | 118.0767 (72)  |
| Total internal gains                                                                | 596.2057  | 611.7659  | 584.3006  | 563.2211  | 532.9809  | 510.1667  | 489.2938  | 490.1705  | 506.1486  | 526.9987  | 561.0986  | 583.1006 (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   |               |
|-------------|------------|----------|--------------------------------|----------|------------------------------|----------|------------------------------|----------|------------------------------|----------|--------------|---------------|
| North       | 1.7800     |          | 10.6334                        |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 5.7845 (74)  |               |
| East        | 4.1000     |          | 19.6403                        |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 24.6095 (76) |               |
| South       | 0.9600     |          | 46.7521                        |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 13.7165 (78) |               |
| West        | 7.4400     |          | 19.6403                        |          | 0.6300                       |          | 0.7000                       |          | 0.7700                       |          | 44.6573 (80) |               |
| Solar gains | 88.7678    | 169.0190 | 270.5495                       | 387.9647 | 473.1990                     | 484.2412 | 461.0277                     | 396.9046 | 312.0094                     | 198.1713 | 109.7622     | 73.6362 (83)  |
| Total gains | 684.9735   | 780.7849 | 854.8501                       | 951.1858 | 1006.1798                    | 994.4079 | 950.3215                     | 887.0751 | 818.1581                     | 725.1700 | 670.8608     | 656.7368 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 67.9807                   | 68.1562 | 68.3291 | 69.1532 | 69.3096 | 70.0470 | 70.0470 | 70.1853 | 69.7611 | 69.3096 | 68.9939 | 68.6670      |
| alpha                                                                       | 5.5320                    | 5.5437  | 5.5553  | 5.6102  | 5.6206  | 5.6698  | 5.6698  | 5.6790  | 5.6507  | 5.6206  | 5.5996  | 5.5778       |
| util living area                                                            | 0.9985                    | 0.9966  | 0.9913  | 0.9681  | 0.8943  | 0.7251  | 0.5487  | 0.6068  | 0.8581  | 0.9809  | 0.9967  | 0.9989 (86)  |
| MIT                                                                         | 19.7452                   | 19.9016 | 20.1470 | 20.4963 | 20.7891 | 20.9544 | 20.9921 | 20.9865 | 20.8795 | 20.4968 | 20.0656 | 19.7251 (87) |
| Th 2                                                                        | 19.9372                   | 19.9397 | 19.9421 | 19.9533 | 19.9554 | 19.9653 | 19.9653 | 19.9671 | 19.9615 | 19.9554 | 19.9512 | 19.9467 (88) |
| util rest of house                                                          | 0.9980                    | 0.9953  | 0.9877  | 0.9539  | 0.8486  | 0.6291  | 0.4247  | 0.4795  | 0.7829  | 0.9698  | 0.9951  | 0.9984 (89)  |
| MIT 2                                                                       | 18.4795                   | 18.6813 | 18.9954 | 19.4398 | 19.7793 | 19.9410 | 19.9631 | 19.9629 | 19.8816 | 19.4483 | 18.9000 | 18.4607 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 18.6983                   | 18.8922 | 19.1945 | 19.6224 | 19.9538 | 20.1161 | 20.1410 | 20.1398 | 20.0540 | 19.6296 | 19.1015 | 18.6793 (92) |
| Temperature adjustment                                                      | 0.0000                    |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 18.6983                   | 18.8922 | 19.1945 | 19.6224 | 19.9538 | 20.1161 | 20.1410 | 20.1398 | 20.0540 | 19.6296 | 19.1015 | 18.6793 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |           |           |                            |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|----------------------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                        |
| Utilisation                                                                    | 0.9969    | 0.9933    | 0.9841    | 0.9481    | 0.8485    | 0.6442   | 0.4463   | 0.5016   | 0.7907   | 0.9650    | 0.9932    | 0.9976 (94)                |
| Useful gains                                                                   | 682.8745  | 775.5905  | 841.2257  | 901.8107  | 853.7458  | 640.5652 | 424.1384 | 444.9996 | 646.9294 | 699.7629  | 666.2971  | 655.1406 (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                                                               | 1787.6159 | 1732.7274 | 1568.0436 | 1308.6644 | 1005.1030 | 664.6530 | 426.6587 | 449.7327 | 720.3577 | 1099.5680 | 1468.1563 | 1779.7050 (97)             |
| Space heating kWh                                                              | 821.9276  | 643.1960  | 540.7526  | 292.9347  | 112.6097  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 297.4550  | 577.3386  | 836.6759 (98a)             |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |           |           | 4122.8900                  |
| 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                                                              | 821.9276  | 643.1960  | 540.7526  | 292.9347  | 112.6097  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 297.4550  | 577.3386  | 836.6759 (98c)             |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |           | 4122.8900                  |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          |           |           | (98c) / (4) = 39.1352 (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 %)                      |          |          |          |          |          |        |        |        |        |          |          | 92.4000 (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                                             | 821.9276 | 643.1960 | 540.7526 | 292.9347 | 112.6097 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 297.4550 | 577.3386 | 836.6759 (98)  |
| Space heating efficiency (main heating system 1)                      | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.4000  | 92.4000  | 92.4000 (210)  |
| Space heating fuel (main heating system)                              | 889.5321 | 696.0995 | 585.2300 | 317.0289 | 121.8720 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 321.9210 | 624.8253 | 905.4934 (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                                                         |          |          |          |          |          |        |        |        |        |          |          |                |

# Full SAP Calculation Printout



|                                                                                                      |          |          |           |           |           |           |           |           |           |           |          |                  |
|------------------------------------------------------------------------------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|------------------|
| Water heating requirement                                                                            | 247.6317 | 218.9384 | 232.7300  | 205.2664  | 199.3428  | 180.0458  | 178.1372  | 185.0670  | 186.9083  | 207.8817  | 220.3336 | 245.0413 (64)    |
| Efficiency of water heater                                                                           |          |          |           |           |           |           |           |           |           |           |          | 80.3000 (216)    |
| (217)m                                                                                               | 86.7490  | 86.5462  | 86.1247   | 85.1430   | 83.2056   | 80.3000   | 80.3000   | 80.3000   | 80.3000   | 85.1486   | 86.3457  | 86.7943 (217)    |
| Fuel for water heating, kWh/month                                                                    | 285.4578 | 252.9730 | 270.2245  | 241.0844  | 239.5785  | 224.2165  | 221.8396  | 230.4695  | 232.7625  | 244.1400  | 255.1762 | 282.3243 (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                                                                                         | 7.3041   | 6.5973   | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041    | 7.0685   | 7.3041 (231)     |
| Lighting                                                                                             | 29.9718  | 24.0445  | 21.6494   | 15.8613   | 12.2517   | 10.0097   | 11.1764   | 14.5275   | 18.8698   | 24.7582   | 27.9643  | 30.8048 (232)    |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |           |           |           |           |           |           |           |           |          |                  |
| (233a)m                                                                                              | -53.1313 | -73.2472 | -102.9542 | -113.0731 | -119.6653 | -110.8385 | -109.4153 | -104.3660 | -95.1633  | -82.4447  | -57.8000 | -46.1279 (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                                                                                              | -35.2330 | -73.4663 | -144.8665 | -215.9569 | -284.0367 | -284.8965 | -281.5856 | -239.1330 | -176.2056 | -104.5604 | -46.8684 | -27.9143 (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                                                                   |          |          |           |           |           |           |           |           |           |           |          | 4462.0022 (211)  |
| Space heating fuel - main system 2                                                                   |          |          |           |           |           |           |           |           |           |           |          | 0.0000 (213)     |
| Space heating fuel - secondary                                                                       |          |          |           |           |           |           |           |           |           |           |          | 0.0000 (215)     |
| Efficiency of water heater                                                                           |          |          |           |           |           |           |           |           |           |           |          | 80.3000          |
| Water heating fuel used                                                                              |          |          |           |           |           |           |           |           |           |           |          | 2980.2467 (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)                                                  |          |          |           |           |           |           |           |           |           |           |          | 241.8894 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |           |           |           |           |           |           |           |           |          |                  |
| PV generation                                                                                        |          |          |           |           |           |           |           |           |           |           |          | -2982.9500 (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                                                                  |          |          |           |           |           |           |           |           |           |           |          | 4787.1883 (238)  |

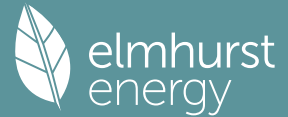
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 4462.0022          | 0.2100                        | 937.0205 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2980.2467          | 0.2100                        | 625.8518 (264)           |
| Space and water heating                       |                    |                               | 1562.8723 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 241.8894           | 0.1443                        | 34.9121 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -1068.2268         | 0.1351                        | -144.3010                |
| PV Unit electricity exported                  | -1914.7231         | 0.1261                        | -241.4741                |
| Total                                         |                    |                               | -385.7751 (269)          |
| Total CO2, kg/year                            |                    |                               | 1223.9385 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 11.6200 (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               | 4462.0022          | 1.1300                              | 5042.0624 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2980.2467          | 1.1300                              | 3367.6788 (278)            |
| Space and water heating                     |                    |                                     | 8409.7412 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 241.8894           | 1.5338                              | 371.0180 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -1068.2268         | 1.4993                              | -1601.5685                 |
| PV Unit electricity exported                | -1914.7231         | 0.4629                              | -886.3945                  |
| Total                                       |                    |                                     | -2487.9630 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 6422.8970 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 60.9700 (287)              |

# Full SAP Calculation Printout



|                                    |                        |  |               |               |                |             |           |  |
|------------------------------------|------------------------|--|---------------|---------------|----------------|-------------|-----------|--|
| Property Reference                 | HT6 SD                 |  |               |               | Issued on Date | 22/11/2024  |           |  |
| Assessment Reference               | LZC                    |  |               | Prop Type Ref |                |             |           |  |
| Property                           |                        |  |               |               |                |             |           |  |
|                                    |                        |  |               |               |                |             |           |  |
| SAP Rating                         | 90 B                   |  | DER           | 1.58          |                | TER         | 11.38     |  |
| Environmental                      | 99 A                   |  | % DER < TER   |               |                |             | 86.12     |  |
| CO <sub>2</sub> Emissions (t/year) | 0.11                   |  | DFEE          | 38.75         |                | TFEE        | 43.79     |  |
| Compliance Check                   | See BREL               |  | % DFEE < TFEE |               |                |             | 11.50     |  |
| % DPER < TPER                      | 58.50                  |  | DPER          | 24.78         |                | TPER        | 59.71     |  |
|                                    |                        |  |               |               |                |             |           |  |
| Assessor Details                   | Mr. Michael Woodbridge |  |               |               |                | Assessor ID | M818-0001 |  |
| Client                             |                        |  |               |               |                |             |           |  |

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

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 45.0000 (1b)              | x 2.3100 (2b)                   | = 103.9500 (1b) - (3b)      |
| First floor                                            | 60.3500 (1c)              | x 2.6200 (2c)                   | = 158.1170 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.3500                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 262.0670 (5)              |

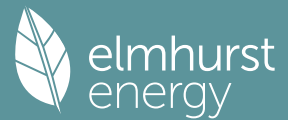
## 2. Ventilation rate

|                                                                                                         | 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                                                                                    | 4.0000 (17)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate                                                                                       | 0.2000 (18)                                                                     |            |            |            |            |            |            |            |            |            |            |                 |
| Number of sides sheltered                                                                               | 2 (19)                                                                          |            |            |            |            |            |            |            |            |            |            |                 |
| Shelter factor                                                                                          | (20) = 1 - [0.075 x (19)] = 0.8500 (20)                                         |            |            |            |            |            |            |            |            |            |            |                 |
| Infiltration rate adjusted to include shelter factor                                                    | (21) = (18) x (20) = 0.1700 (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                                                                                         | 0.2167                                                                          | 0.2125     | 0.2083     | 0.1870     | 0.1827     | 0.1615     | 0.1615     | 0.1573     | 0.1700     | 0.1827     | 0.1913     | 0.1998 (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) =            |                                                                                 |            |            |            |            |            |            |            |            |            |            | 81.9000 (23c)   |
| Effective ac                                                                                            | 0.3072                                                                          | 0.3030     | 0.2987     | 0.2775     | 0.2732     | 0.2520     | 0.2520     | 0.2477     | 0.2605     | 0.2732     | 0.2817     | 0.2903 (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    |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------|
| External Doors                                              |                         |                            | 2.1000                    | 1.0000                        | 2.1000       |                                | (26)             |
| Glazing (Uw = 0.80)                                         |                         |                            | 14.2800                   | 0.7752                        | 11.0698      |                                | (27)             |
| Ground Floor                                                |                         |                            | 45.0000                   | 0.1200                        | 5.4000       | 75.0000                        | 3375.0000 (28a)  |
| Exposed Floor                                               |                         |                            | 15.3500                   | 0.1200                        | 1.8420       | 20.0000                        | 307.0000 (28b)   |
| External Wall                                               | 113.7400                | 16.3800                    | 97.3600                   | 0.1500                        | 14.6040      | 150.0000                       | 14603.9997 (29a) |
| Split Level GF                                              | 7.2100                  |                            | 7.2100                    | 0.1500                        | 1.0815       | 60.0000                        | 432.6000 (29a)   |
| Split Level TF                                              | 7.2100                  |                            | 7.2100                    | 0.1500                        | 1.0815       | 9.0000                         | 64.8900 (29a)    |
| External Roof                                               | 60.3500                 |                            | 60.3500                   | 0.1100                        | 6.6385       | 9.0000                         | 543.1500 (30)    |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 248.8600                  |                               |              |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 43.8173      |                                | (33)             |
| Party Wall                                                  |                         |                            | 42.6000                   | 0.0000                        | 0.0000       | 45.0000                        | 1916.9999 (32)   |
| Internal Wall Stud                                          |                         |                            | 96.4800                   |                               |              | 9.0000                         | 868.3200 (32c)   |
| Internal Wall Block                                         |                         |                            | 94.1000                   |                               |              | 75.0000                        | 7057.4999 (32c)  |
| Internal Floor 1                                            |                         |                            | 45.0000                   |                               |              | 18.0000                        | 810.0000 (32d)   |

# Full SAP Calculation Printout



Internal Ceiling 1 45.0000 9.0000 405.0000 (32e)

Heat capacity  $C_m = \text{Sum}(A \times k)$  (28)...(30) + (32) + (32a)...(32e) = 30384.4595 (34)  
Thermal mass parameter (TMP =  $C_m / \text{TFA}$ ) in kJ/m<sup>2</sup>K 288.4144 (35)

| List of Thermal Bridges                                                   | Length  | Psi-value | Total   |
|---------------------------------------------------------------------------|---------|-----------|---------|
| K1 Element                                                                |         |           |         |
| E2 Other lintels (including other steel lintels)                          | 13.2140 | 0.0500    | 0.6607  |
| E3 Sill                                                                   | 10.7140 | 0.0500    | 0.5357  |
| E4 Jamb                                                                   | 35.9700 | 0.0500    | 1.7985  |
| E5 Ground floor (normal)                                                  | 20.3600 | 0.1600    | 3.2576  |
| E6 Intermediate floor within a dwelling                                   | 20.3600 | 0.0000    | 0.0000  |
| E10 Eaves (insulation at ceiling level)                                   | 18.3000 | 0.0600    | 1.0980  |
| E12 Gable (insulation at ceiling level)                                   | 10.3900 | 0.0600    | 0.6234  |
| E16 Corner (normal)                                                       | 17.1000 | 0.0900    | 1.5390  |
| E17 Corner (inverted - internal area greater than external area)          | 7.2400  | -0.0900   | -0.6516 |
| E19 Ground floor (inverted)                                               | 5.0000  | 0.0700    | 0.3500  |
| E22 Basement floor                                                        | 5.0000  | 0.0700    | 0.3500  |
| E24 Eaves (insulation at ceiling level - inverted)                        | 10.0000 | 0.1500    | 1.5000  |
| E18 Party wall between dwellings                                          | 9.8600  | 0.0600    | 0.5916  |
| P1 Party wall - Ground floor                                              | 8.6400  | 0.0800    | 0.6912  |
| P2 Party wall - Intermediate floor within a dwelling                      | 8.6400  | 0.0000    | 0.0000  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 0.0000  | 0.0000    | 0.0000  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 8.6400  | 0.1200    | 1.0368  |
| E20 Exposed floor (normal)                                                | 11.7000 | 0.3200    | 3.7440  |
| E21 Exposed floor (inverted)                                              | 5.0000  | 0.3200    | 1.6000  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 18.7249 (36)  
Point Thermal bridges 0.0000  
Total fabric heat loss (33) + (36) + (36a) = 62.5422 (37)

|                                                                     |                |                |                |                |                |                |                |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                |                |                |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>26.5716 | Feb<br>26.2041 | Mar<br>25.8365 | Apr<br>23.9988 | May<br>23.6312 | Jun<br>21.7935 | Jul<br>21.7935 | Aug<br>21.4259 | Sep<br>22.5286 | Oct<br>23.6312 | Nov<br>24.3663 | Dec<br>25.1014 (38) |
| Heat transfer coeff                                                 | 89.1138        | 88.7462        | 88.3787        | 86.5410        | 86.1734        | 84.3357        | 84.3357        | 83.9681        | 85.0708        | 86.1734        | 86.9085        | 87.6436 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                |                |                |                |                |                |                |                | 86.4491             |
| HLP                                                                 | Jan<br>0.8459  | Feb<br>0.8424  | Mar<br>0.8389  | Apr<br>0.8215  | May<br>0.8180  | Jun<br>0.8005  | Jul<br>0.8005  | Aug<br>0.7970  | Sep<br>0.8075  | Oct<br>0.8180  | Nov<br>0.8250  | Dec<br>0.8319 (40)  |
| HLP (average)                                                       |                |                |                |                |                |                |                |                |                |                |                | 0.8206              |
| Days in mont                                                        | 31             | 28             | 31             | 30             | 31             | 30             | 31             | 31             | 30             | 31             | 30             | 31                  |

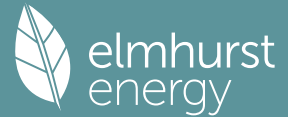
## 4. Water heating energy requirements (kWh/year)

|                                                                                |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                      |
|--------------------------------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------------|
| Assumed occupancy                                                              |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 2.7838 (42)          |
| Hot water usage for mixer showers                                              |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 70.6240 (42a)        |
| Hot water usage for baths                                                      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 30.5072 (42b)        |
| Hot water usage for other uses                                                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 43.1393 (42c)        |
| Average daily hot water use (litres/day)                                       |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 132.9619 (43)        |
| Daily hot water use                                                            | Jan<br>144.6456 | Feb<br>141.5569 | Mar<br>137.7955 | Apr<br>132.0759 | May<br>127.4312 | Jun<br>122.4378 | Jul<br>120.5188 | Aug<br>124.2640 | Sep<br>128.2139 | Oct<br>133.4561 | Nov<br>139.2638 | Dec<br>144.2705 (44) |
| Energy content (annual)                                                        | 229.0833        | 201.5751        | 211.7865        | 180.8053        | 171.5469        | 150.5515        | 145.7571        | 153.8648        | 158.1005        | 181.0987        | 198.4068        | 225.8928 (45)        |
| Distribution loss (46)m = 0.15 x (45)m                                         |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 2208.4693            |
| Water storage loss:                                                            | 34.3625         | 30.2363         | 31.7680         | 27.1208         | 25.7320         | 22.5827         | 21.8636         | 23.0797         | 23.7151         | 27.1648         | 29.7610         | 33.8839 (46)         |
| Store volume                                                                   |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 250.0000 (47)        |
| a) If manufacturer declared loss factor is known (kWh/day):                    |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 1.8400 (48)          |
| Temperature factor from Table 2b                                               |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 0.5400 (49)          |
| Enter (49) or (54) in (55)                                                     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 0.9936 (55)          |
| Total storage loss                                                             | 30.8016         | 27.8208         | 30.8016         | 29.8080         | 30.8016         | 29.8080         | 30.8016         | 30.8016         | 29.8080         | 30.8016         | 29.8080         | 30.8016 (56)         |
| If cylinder contains dedicated solar storage                                   | 30.8016         | 27.8208         | 30.8016         | 29.8080         | 30.8016         | 29.8080         | 30.8016         | 30.8016         | 29.8080         | 30.8016         | 29.8080         | 30.8016 (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                | 283.1473        | 250.4071        | 265.8505        | 233.1253        | 225.6109        | 202.8715        | 199.8211        | 207.9288        | 210.4205        | 235.1627        | 250.7268        | 279.9568 (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                                                                | 283.1473        | 250.4071        | 265.8505        | 233.1253        | 225.6109        | 202.8715        | 199.8211        | 207.9288        | 210.4205        | 235.1627        | 250.7268        | 279.9568 (64)        |
| 12Total per year (kWh/year)                                                    |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 | 2845.0293 (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                                       | 119.4214        | 106.0893        | 113.6702        | 101.9738        | 100.2905        | 91.9144         | 91.7154         | 94.4112         | 94.4244         | 103.4665        | 107.8263        | 118.3605 (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                                                                               | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 148.5750  | 164.4938  | 148.5750  | 153.5275  | 148.5750  | 153.5275  | 148.5750  | 148.5750  | 153.5275  | 148.5750  | 153.5275  | 148.5750 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 264.6980  | 267.4448  | 260.5231  | 245.7876  | 227.1868  | 209.7046  | 198.0254  | 195.2787  | 202.2003  | 216.9358  | 235.5367  | 253.0189 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192 (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    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 (71) |
| Water heating gains (Table 5)                                                       | 160.5126  | 157.8710  | 152.7825  | 141.6302  | 134.7991  | 127.6589  | 123.2734  | 126.8968  | 131.1450  | 139.0679  | 149.7587  | 159.0868 (72)  |
| Total internal gains                                                                | 641.5433  | 657.5672  | 629.6382  | 608.7030  | 578.3185  | 555.6485  | 534.6314  | 535.5081  | 551.6305  | 572.3363  | 606.5805  | 628.4382 (73)  |

# Full SAP Calculation Printout



## 6. Solar gains

| [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    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|------------------------------|----------|------------------------------|----------|------------------------------|---------------|
| North       |          |          |          |          | 1.7800     | 10.6334                        |                              | 0.5000   |                              | 0.7000   | 0.7700                       | 4.5908 (74)   |
| East        |          |          |          |          | 4.1000     | 19.6403                        |                              | 0.5000   |                              | 0.7000   | 0.7700                       | 19.5314 (76)  |
| South       |          |          |          |          | 0.9600     | 46.7521                        |                              | 0.5000   |                              | 0.7000   | 0.7700                       | 10.8861 (78)  |
| West        |          |          |          |          | 7.4400     | 19.6403                        |                              | 0.5000   |                              | 0.7000   | 0.7700                       | 35.4423 (80)  |
| Solar gains | 70.4506  | 134.1421 | 214.7218 | 307.9085 | 375.5547   | 384.3184                       | 365.8950                     | 315.0037 | 247.6265                     | 157.2788 | 87.1128                      | 58.4414 (83)  |
| Total gains | 711.9939 | 791.7093 | 844.3601 | 916.6114 | 953.8732   | 939.9670                       | 900.5264                     | 850.5118 | 799.2570                     | 729.6151 | 693.6933                     | 686.8796 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |          |          |          |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|----------|----------|----------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |          |          |          |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |          |          |          |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun      | Jul      | Aug      | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 94.7118                   | 95.1041 | 95.4996 | 97.5276 | 97.9435 | 100.0778 | 100.0778 | 100.5159 | 99.2130 | 97.9435 | 97.1151 | 96.3006      |
| alpha                                                                       | 7.3141                    | 7.3403  | 7.3666  | 7.5018  | 7.5296  | 7.6719   | 7.6719   | 7.7011   | 7.6142  | 7.5296  | 7.4743  | 7.4200       |
| util living area                                                            | 0.9976                    | 0.9941  | 0.9837  | 0.9322  | 0.7934  | 0.5707   | 0.4118   | 0.4536   | 0.7144  | 0.9522  | 0.9932  | 0.9981 (86)  |
| MIT                                                                         | 20.2575                   | 20.3871 | 20.5691 | 20.8154 | 20.9572 | 20.9968  | 20.9998  | 20.9995  | 20.9846 | 20.8068 | 20.5028 | 20.2472 (87) |
| Th 2                                                                        | 20.2137                   | 20.2167 | 20.2197 | 20.2348 | 20.2378 | 20.2529  | 20.2529  | 20.2559  | 20.2468 | 20.2378 | 20.2318 | 20.2257 (88) |
| util rest of house                                                          | 0.9968                    | 0.9920  | 0.9778  | 0.9100  | 0.7433  | 0.5058   | 0.3420   | 0.3805   | 0.6451  | 0.9315  | 0.9904  | 0.9975 (89)  |
| MIT 2                                                                       | 19.3461                   | 19.5134 | 19.7453 | 20.0542 | 20.2049 | 20.2513  | 20.2528  | 20.2558  | 20.2378 | 20.0521 | 19.6734 | 19.3425 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |          |          |          |         |         |         |              |
| MIT                                                                         | 19.5036                   | 19.6644 | 19.8877 | 20.1858 | 20.3349 | 20.3802  | 20.3819  | 20.3843  | 20.3669 | 20.1826 | 19.8168 | 19.4989 (92) |
| Temperature adjustment                                                      | 0.0000                    |         |         |         |         |          |          |          |         |         |         |              |
| adjusted MIT                                                                | 19.5036                   | 19.6644 | 19.8877 | 20.1858 | 20.3349 | 20.3802  | 20.3819  | 20.3843  | 20.3669 | 20.1826 | 19.8168 | 19.4989 (93) |

## 8. Space heating requirement

|                                                                                |               |           |           |          |          |          |          |          |          |          |           |                |
|--------------------------------------------------------------------------------|---------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
|                                                                                | Jan           | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
| Utilisation                                                                    | 0.9957        | 0.9900    | 0.9746    | 0.9084   | 0.7500   | 0.5170   | 0.3541   | 0.3932   | 0.6565   | 0.9297   | 0.9883    | 0.9966 (94)    |
| Useful gains                                                                   | 708.9242      | 783.8297  | 822.9479  | 832.6504 | 715.4335 | 485.9450 | 318.8792 | 334.4019 | 524.7391 | 678.3222 | 685.5889  | 684.5295 (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                                                               | 1354.8524     | 1310.2879 | 1183.1885 | 976.6846 | 744.1010 | 487.4732 | 318.9509 | 334.5557 | 533.1284 | 825.7611 | 1105.1964 | 1340.8517 (97) |
| Space heating kWh                                                              | 480.5706      | 353.7800  | 268.0190  | 103.7047 | 21.3286  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 109.6946 | 302.1174  | 488.3037 (98a) |
| Space heating requirement - total per year (kWh/year)                          | 2127.5185     |           |           |          |          |          |          |          |          |          |           |                |
| 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                                                              | 480.5706      | 353.7800  | 268.0190  | 103.7047 | 21.3286  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 109.6946 | 302.1174  | 488.3037 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | 2127.5185     |           |           |          |          |          |          |          |          |          |           |                |
| Space heating per m2                                                           | (98c) / (4) = |           |           |          |          |          |          |          |          |          |           |                |
|                                                                                | 20.1948 (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 %)                                                     |          |          |          |           |           |           |           |           |          |          |          | 249.9000 (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                                                                            | 480.5706 | 353.7800 | 268.0190 | 103.7047  | 21.3286   | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 109.6946 | 302.1174 | 488.3037 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 249.9000 | 249.9000 | 249.9000 | 249.9000  | 249.9000  | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 249.9000 | 249.9000 | 249.9000 (210)  |
| Space heating fuel (main heating system)                                                             | 192.3052 | 141.5686 | 107.2505 | 41.4985   | 8.5349    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 43.8954  | 120.8953 | 195.3996 (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                                                                            | 283.1473 | 250.4071 | 265.8505 | 233.1253  | 225.6109  | 202.8715  | 199.8211  | 207.9288  | 210.4205 | 235.1627 | 250.7268 | 279.9568 (64)   |
| Efficiency of water heater                                                                           | 175.1000 | 175.1000 | 175.1000 | 175.1000  | 175.1000  | 175.1000  | 175.1000  | 175.1000  | 175.1000 | 175.1000 | 175.1000 | 175.1000 (216)  |
| Fuel for water heating, kWh/month                                                                    | 161.7061 | 143.0081 | 151.8278 | 133.1384  | 128.8469  | 115.8604  | 114.1183  | 118.7486  | 120.1716 | 134.3019 | 143.1906 | 159.8839 (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                                                                                         | 21.7236  | 19.6213  | 21.7236  | 21.0228   | 21.7236   | 21.0228   | 21.7236   | 21.7236   | 21.0228  | 21.7236  | 21.0228  | 21.7236 (231)   |
| Lighting                                                                                             | 39.6650  | 31.8207  | 28.6510  | 20.9910   | 16.2140   | 13.2470   | 14.7910   | 19.2259   | 24.9725  | 32.7653  | 37.0083  | 40.7674 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -38.0862 | -60.9555 | -99.1942 | -120.3316 | -134.5113 | -127.1029 | -125.0308 | -114.4628 | -94.9765 | -72.2318 | -43.6107 | -31.8751 (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)                                        | -11.2987 | -28.2884 | -69.1411 | -126.0146 | -185.6552 | -193.6203 | -188.9798 | -149.7513 | -97.3182 | -46.4724 | -16.3584 | -8.4888 (233b)  |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |          |          |          |                 |

# Full SAP Calculation Printout



|                                                                                                      |        |        |        |        |        |        |        |        |        |        |        |            |        |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|--------|
| (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                                                                   |        |        |        |        |        |        |        |        |        |        |        | 851.3479   | (211)  |
| Space heating fuel - main system 2                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (213)  |
| Space heating fuel - secondary                                                                       |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (215)  |
| Efficiency of water heater                                                                           |        |        |        |        |        |        |        |        |        |        |        | 175.1000   |        |
| Water heating fuel used                                                                              |        |        |        |        |        |        |        |        |        |        |        | 1624.8026  | (219)  |
| Space cooling fuel                                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.0000     | (221)  |
| Electricity for pumps and fans:                                                                      |        |        |        |        |        |        |        |        |        |        |        |            |        |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.6000, SFP = 0.8000)                           |        |        |        |        |        |        |        |        |        |        |        |            |        |
| mechanical ventilation fans (SFP = 0.8000)                                                           |        |        |        |        |        |        |        |        |        |        |        | 255.7774   | (230a) |
| Total electricity for the above, kWh/year                                                            |        |        |        |        |        |        |        |        |        |        |        | 255.7774   | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                  |        |        |        |        |        |        |        |        |        |        |        | 320.1190   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |        |        |        |        |        |        |        |        |        |        |        |            |        |
| PV generation                                                                                        |        |        |        |        |        |        |        |        |        |        |        | -2183.7566 | (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                                                                  |        |        |        |        |        |        |        |        |        |        |        | 868.2902   | (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                   | 851.3479           | 0.1569                        | 133.5420 (261)           |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (273)             |
| Water heating (other fuel)                      | 1624.8026          | 0.1409                        | 228.9947 (264)           |
| Space and water heating                         |                    |                               | 362.5367 (265)           |
| Pumps, fans and electric keep-hot               | 255.7774           | 0.1387                        | 35.4795 (267)            |
| Energy for lighting                             | 320.1190           | 0.1443                        | 46.2031 (268)            |
| Energy saving/generation technologies           |                    |                               |                          |
| PV Unit electricity used in dwelling            | -1062.3694         | 0.1330                        | -141.2427                |
| PV Unit electricity exported                    | -1121.3872         | 0.1216                        | -136.3106                |
| Total                                           |                    |                               | -277.5533 (269)          |
| Total CO2, kg/year                              |                    |                               | 166.6660 (272)           |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 1.5800 (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               | 851.3479           | 1.5807                              | 1345.7390 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 1624.8026          | 1.5211                              | 2471.5449 (278)            |
| Space and water heating                     |                    |                                     | 3817.2839 (279)            |
| Pumps, fans and electric keep-hot           | 255.7774           | 1.5128                              | 386.9400 (281)             |
| Energy for lighting                         | 320.1190           | 1.5338                              | 491.0091 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -1062.3694         | 1.4913                              | -1584.2938                 |
| PV Unit electricity exported                | -1121.3872         | 0.4460                              | -500.1235                  |
| Total                                       |                    |                                     | -2084.4173 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 2610.8158 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 24.7800 (287)              |

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

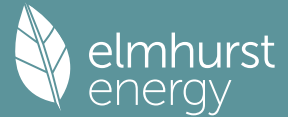
### 1. Overall dwelling characteristics

|                                                        | Area<br>(m2) | Storey height<br>(m)            | Volume<br>(m3)         |
|--------------------------------------------------------|--------------|---------------------------------|------------------------|
| Ground floor                                           | 45.0000 (1b) | x 2.3100 (2b)                   | = 103.9500 (1b) - (3b) |
| First floor                                            | 60.3500 (1c) | x 2.6200 (2c)                   | = 158.1170 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.3500     |                                 | (4)                    |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 262.0670 (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                | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                       | 0 * 40 = 0.0000 (7c)  |

# Full SAP Calculation Printout



Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.1526 (8)  
Pressure test Yes  
Pressure Test Method Blower Door  
Measured/design AP50 5.0000 (17)  
Infiltration rate 0.4026 (18)  
Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)  
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3422 (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 |        |        |        |        |        |        |        |        |        |        |        |        |       |
|                 | 0.4364 | 0.4278 | 0.4192 | 0.3765 | 0.3679 | 0.3251 | 0.3251 | 0.3166 | 0.3422 | 0.3679 | 0.3850 | 0.4021 | (22b) |
| Effective ac    | 0.5952 | 0.5915 | 0.5879 | 0.5709 | 0.5677 | 0.5529 | 0.5529 | 0.5501 | 0.5586 | 0.5677 | 0.5741 | 0.5809 | (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                                |             |                | 2.1000        | 1.0000               | 2.1000       |                   |               | (26)  |
| TER Opening Type (Uw = 1.20)                   |             |                | 14.2800       | 1.1450               | 16.3511      |                   |               | (27)  |
| Ground Floor                                   |             |                | 45.0000       | 0.1300               | 5.8500       |                   |               | (28a) |
| Exposed Floor                                  |             |                | 15.3500       | 0.1300               | 1.9955       |                   |               | (28b) |
| External Wall                                  | 113.7400    | 16.3800        | 97.3600       | 0.1800               | 17.5248      |                   |               | (29a) |
| Split Level GF                                 |             |                | 7.2100        | 0.1800               | 1.2978       |                   |               | (29a) |
| Split Level TF                                 |             |                | 7.2100        | 0.1800               | 1.2978       |                   |               | (29a) |
| External Roof                                  |             |                | 60.3500       | 0.1100               | 6.6385       |                   |               | (30)  |
| Total net area of external elements Aum(A, m2) |             |                | 248.8600      |                      |              |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               | (26)...(30) + (32) = | 53.0555      |                   |               | (33)  |
| Party Wall                                     |             |                | 42.6000       | 0.0000               | 0.0000       |                   |               | (32)  |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

288.4144 (35)

#### List of Thermal Bridges

|                                                                           | Length  | Psi-value | Total   |  |
|---------------------------------------------------------------------------|---------|-----------|---------|--|
| K1 Element                                                                | 13.2140 | 0.0500    | 0.6607  |  |
| E2 Other lintels (including other steel lintels)                          | 10.7140 | 0.0500    | 0.5357  |  |
| E3 Sill                                                                   | 35.9700 | 0.0500    | 1.7985  |  |
| E4 Jamb                                                                   | 20.3600 | 0.1600    | 3.2576  |  |
| E5 Ground floor (normal)                                                  | 20.3600 | 0.0000    | 0.0000  |  |
| E6 Intermediate floor within a dwelling                                   | 18.3000 | 0.0600    | 1.0980  |  |
| E10 Eaves (insulation at ceiling level)                                   | 10.3900 | 0.0600    | 0.6234  |  |
| E12 Gable (insulation at ceiling level)                                   | 17.1000 | 0.0900    | 1.5390  |  |
| E16 Corner (normal)                                                       | 7.2400  | -0.0900   | -0.6516 |  |
| E17 Corner (inverted - internal area greater than external area)          | 5.0000  | 0.0700    | 0.3500  |  |
| E19 Ground floor (inverted)                                               | 5.0000  | 0.0700    | 0.3500  |  |
| E22 Basement floor                                                        | 10.0000 | 0.2400    | 2.4000  |  |
| E24 Eaves (insulation at ceiling level - inverted)                        | 9.8600  | 0.0600    | 0.5916  |  |
| E18 Party wall between dwellings                                          | 8.6400  | 0.0800    | 0.6912  |  |
| P1 Party wall - Ground floor                                              | 8.6400  | 0.0000    | 0.0000  |  |
| P2 Party wall - Intermediate floor within a dwelling                      | 0.0000  | 0.0000    | 0.0000  |  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 8.6400  | 0.1200    | 1.0368  |  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 11.7000 | 0.3200    | 3.7440  |  |
| E20 Exposed floor (normal)                                                | 5.0000  | 0.3200    | 1.6000  |  |
| E21 Exposed floor (inverted)                                              |         |           |         |  |

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

19.6249 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 72.6804 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

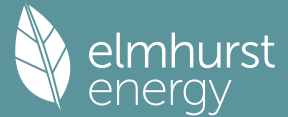
|                           |          |          |          |          |          |          |          |          |          |          |          |          |          |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| (38)m                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |          |
|                           | 51.4743  | 51.1546  | 50.8412  | 49.3693  | 49.0939  | 47.8119  | 47.8119  | 47.5745  | 48.3057  | 49.0939  | 49.6510  | 50.2335  | (38)     |
| Heat transfer coeff       | 124.1548 | 123.8351 | 123.5217 | 122.0498 | 121.7744 | 120.4924 | 120.4924 | 120.2550 | 120.9862 | 121.7744 | 122.3315 | 122.9139 | (39)     |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          |          | 122.0484 |

|               |        |        |        |        |        |        |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |        |
|               | 1.1785 | 1.1755 | 1.1725 | 1.1585 | 1.1559 | 1.1437 | 1.1437 | 1.1415 | 1.1484 | 1.1559 | 1.1612 | 1.1667 | (40)   |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        |        | 1.1585 |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |        |

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

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |                              |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------|
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |          |          |          | 2.7838 (42)                  |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |          |          |          |                              |
|                                                                 | 70.8957  | 69.8302  | 68.2777  | 65.3072  | 63.1151  | 60.6704  | 59.2809  | 60.8216  | 62.5106  | 65.1354  | 68.1697  | 70.6240  | (42a)                        |
| Hot water usage for baths                                       |          |          |          |          |          |          |          |          |          |          |          |          |                              |
|                                                                 | 30.6107  | 30.1561  | 29.5159  | 28.3355  | 27.4516  | 26.4716  | 25.9422  | 26.5779  | 27.2701  | 28.3188  | 29.5235  | 30.5072  | (42b)                        |
| Hot water usage for other uses                                  |          |          |          |          |          |          |          |          |          |          |          |          |                              |
|                                                                 | 43.1393  | 41.5706  | 40.0019  | 38.4332  | 36.8645  | 35.2958  | 35.2958  | 36.8645  | 38.4332  | 40.0019  | 41.5706  | 43.1393  | (42c)                        |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |          |          | 132.9619 (43)                |
| Daily hot water use                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                              |
|                                                                 | 144.6456 | 141.5569 | 137.7955 | 132.0759 | 127.4312 | 122.4378 | 120.5188 | 124.2640 | 128.2139 | 133.4561 | 139.2638 | 144.2705 | (44)                         |
| Energy conte                                                    | 229.0833 | 201.5751 | 211.7865 | 180.8053 | 171.5469 | 150.5515 | 145.7571 | 153.8648 | 158.1005 | 181.0987 | 198.4068 | 225.8928 | (45)                         |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = 2208.4693 |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |          |                              |
|                                                                 | 34.3625  | 30.2363  | 31.7680  | 27.1208  | 25.7320  | 22.5827  | 21.8636  | 23.0797  | 23.7151  | 27.1648  | 29.7610  | 33.8839  | (46)                         |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |          |                              |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          |          | 250.0000 (47)                |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          |          | 1.8903 (48)                  |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (49)                  |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          |          | 1.0208 (55)                  |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |          |                              |
|                                                                 | 31.6444  | 28.5820  | 31.6444  | 30.6236  | 31.6444  | 30.6236  | 31.6444  | 31.6444  | 30.6236  | 31.6444  | 30.6236  | 31.6444  | (56)                         |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |          |                              |
|                                                                 | 31.6444  | 28.5820  | 31.6444  | 30.6236  | 31.6444  | 30.6236  | 31.6444  | 31.6444  | 30.6236  | 31.6444  | 30.6236  | 31.6444  | (57)                         |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 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 |          |          |          |          |          |          |          |          |          |          |          |          |                              |

# Full SAP Calculation Printout



|                                                                                |          |          |          |          |          |          |          |          |          |          |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| WWHRS                                                                          | 283.9901 | 251.1684 | 266.6933 | 233.9409 | 226.4537 | 203.6871 | 200.6639 | 208.7716 | 211.2361 | 236.0055 | 251.5424 | 280.7996 (62)  |
| PV diverter                                                                    | -32.4105 | -28.6641 | -30.0154 | -24.8540 | -23.1630 | -19.8207 | -18.5788 | -19.7567 | -20.5073 | -24.1759 | -27.3883 | -31.8103 (63a) |
| 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 (63b)  |
| 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 (63c)   |
| Output from w/h                                                                | 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)   |
| 12Total per year (kWh/year)                                                    | 251.5796 | 222.5042 | 236.6779 | 209.0869 | 203.2906 | 183.8664 | 182.0851 | 189.0149 | 190.7288 | 211.8296 | 224.1541 | 248.9892 (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   | 2553.8073 (64) |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |          |          | 2554 (64)      |
| Heat gains from water heating, kWh/month                                       | 120.0956 | 106.6983 | 114.3444 | 102.6262 | 100.9648 | 92.5669  | 92.3897  | 95.0855  | 95.0769  | 104.1407 | 108.4787 | 119.0348 (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                                                                               | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | 139.1920  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 144.2474  | 159.7025  | 144.2474  | 149.0557  | 144.2474  | 149.0557  | 144.2474  | 144.2474  | 149.0557  | 144.2474  | 149.0557  | 144.2474  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 264.6980  | 267.4448  | 260.5231  | 245.7876  | 227.1868  | 209.7046  | 198.0254  | 195.2787  | 202.2003  | 216.9358  | 235.5367  | 253.0189  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | 36.9192   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | -111.3536 | (71) |
| Water heating gains (Table 5)                                                       | 161.4189  | 158.7773  | 153.6888  | 142.5364  | 135.7053  | 128.5651  | 124.1796  | 127.8031  | 132.0513  | 139.9741  | 150.6649  | 159.9930  | (72) |
| Total internal gains                                                                | 638.1220  | 653.6822  | 626.2169  | 605.1374  | 574.8971  | 552.0829  | 531.2101  | 532.0868  | 548.0649  | 568.9150  | 603.0149  | 625.0169  | (73) |

## 6. Solar gains

| [Jan]       |          |          |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|---------------|
| North       |          |          |          |          |           | 1.7800     | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       | 5.7845 (74)  |               |
| East        |          |          |          |          |           | 4.1000     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 24.6095 (76) |               |
| South       |          |          |          |          |           | 0.9600     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       | 13.7165 (78) |               |
| West        |          |          |          |          |           | 7.4400     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 44.6573 (80) |               |
| <hr/>       |          |          |          |          |           |            |                                |                                   |                                    |                              |              |               |
| Solar gains | 88.7678  | 169.0190 | 270.5495 | 387.9647 | 473.1990  | 484.2412   | 461.0277                       | 396.9046                          | 312.0094                           | 198.1713                     | 109.7622     | 73.6362 (83)  |
| Total gains | 726.8897 | 822.7012 | 896.7664 | 993.1021 | 1048.0961 | 1036.3242  | 992.2378                       | 928.9914                          | 860.0743                           | 767.0862                     | 712.7771     | 698.6531 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 67.9807 | 68.1562 | 68.3291 | 69.1532 | 69.3096 | 70.0470 | 70.0470 | 70.1853 | 69.7611 | 69.3096 | 68.9939 | 68.6670 | (86)         |
| alpha                                                                       | 5.5320  | 5.5437  | 5.5553  | 5.6102  | 5.6206  | 5.6698  | 5.6698  | 5.6790  | 5.6507  | 5.6206  | 5.5996  | 5.5778  |              |
| util living area                                                            | 0.9980  | 0.9956  | 0.9892  | 0.9619  | 0.8798  | 0.7027  | 0.5271  | 0.5824  | 0.8367  | 0.9756  | 0.9955  | 0.9984  | (86)         |
| MIT                                                                         | 19.7826 | 19.9386 | 20.1828 | 20.5274 | 20.8093 | 20.9610 | 20.9935 | 20.9889 | 20.8955 | 20.5304 | 20.1026 | 19.7627 | (87)         |
| Th 2                                                                        | 19.9372 | 19.9397 | 19.9421 | 19.9533 | 19.9554 | 19.9653 | 19.9653 | 19.9671 | 19.9615 | 19.9554 | 19.9512 | 19.9467 | (88)         |
| util rest of house                                                          | 0.9973  | 0.9939  | 0.9847  | 0.9455  | 0.8307  | 0.6069  | 0.4071  | 0.4586  | 0.7573  | 0.9618  | 0.9934  | 0.9978  | (89)         |
| MIT 2                                                                       | 18.5274 | 18.7284 | 19.0404 | 19.4765 | 19.7988 | 19.9449 | 19.9635 | 19.9637 | 19.8941 | 19.4885 | 18.9471 | 18.5089 | (90)         |
| Living area fraction                                                        | 18.7444 | 18.9376 | 19.2378 | 19.6582 | 19.9735 | 20.1205 | 20.1416 | 20.1409 | 20.0672 | 19.6686 | 19.1468 | 18.7256 | (91)         |
| MIT                                                                         | 18.7444 | 18.9376 | 19.2378 | 19.6582 | 19.9735 | 20.1205 | 20.1416 | 20.1409 | 20.0672 | 19.6686 | 19.1468 | 18.7256 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.7444 | 18.9376 | 19.2378 | 19.6582 | 19.9735 | 20.1205 | 20.1416 | 20.1409 | 20.0672 | 19.6686 | 19.1468 | 18.7256 | (93)         |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |           |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |       |
| alpha                                                                          | 0.9960    | 0.9916    | 0.9806    | 0.9396    | 0.8317    | 0.6222   | 0.4280   | 0.4802   | 0.7665   | 0.9567    | 0.9911    | 0.9967    | (94)  |
| Useful gains                                                                   | 723.9568  | 815.7993  | 879.3541  | 933.1260  | 871.6927  | 644.8385 | 424.6896 | 446.0615 | 659.2691 | 733.8991  | 706.4228  | 696.3792  | (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                                                               | 1793.3379 | 1738.3429 | 1573.3978 | 1313.0344 | 1007.4997 | 665.1811 | 426.7303 | 449.8676 | 721.9471 | 1104.3234 | 1473.7058 | 1785.3963 | (97)  |
| Space heating kWh                                                              | 795.6196  | 619.9493  | 516.3685  | 273.5340  | 101.0403  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 275.5957  | 552.4438  | 810.2287  | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |           |           | 3944.7799 |       |
| 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                                                              | 795.6196  | 619.9493  | 516.3685  | 273.5340  | 101.0403  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 275.5957  | 552.4438  | 810.2287  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |           | 3944.7799 |       |
| Space heating per m <sup>2</sup>                                               |           |           |           |           |           |          |          |          |          |           |           | 37.4445   | (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 %)                      | 92.3000 (206) |
| Efficiency of main space heating system 2 (in %)                      | 0.0000 (207)  |
| Efficiency of secondary/supplementary heating system, %               | 0.0000 (208)  |

# Full SAP Calculation Printout



|                                                                                                      | Jan      | Feb      | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov      | Dec        |        |
|------------------------------------------------------------------------------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|------------|--------|
| Space heating requirement                                                                            | 795.6196 | 619.9493 | 516.3685  | 273.5340  | 101.0403  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 275.5957  | 552.4438 | 810.2287   | (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)                                                             | 861.9931 | 671.6677 | 559.4459  | 296.3532  | 109.4695  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 298.5869  | 598.5306 | 877.8209   | (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 requirement                                                                            | 251.5796 | 222.5042 | 236.6779  | 209.0869  | 203.2906  | 183.8664  | 182.0851  | 189.0149  | 190.7288  | 211.8296  | 224.1541 | 248.9892   | (64)   |
| Efficiency of water heater                                                                           | 86.4575  | 86.2314  | 85.7601   | 84.6633   | 82.5787   | 79.8000   | 79.8000   | 79.8000   | 79.8000   | 84.6509   | 86.0004  | 86.5066    | (216)  |
| Fuel for water heating, kWh/month                                                                    | 290.9866 | 258.0316 | 275.9767  | 246.9629  | 246.1780  | 230.4090  | 228.1768  | 236.8608  | 239.0086  | 250.2389  | 260.6430 | 287.8269   | (217)  |
| 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)  |
| (221)m                                                                                               | 7.3041   | 6.5973   | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041   | 7.0685     | (231)  |
| Pumps and Fa                                                                                         | 29.9718  | 24.0445  | 21.6494   | 15.8613   | 12.2517   | 10.0097   | 11.1764   | 14.5275   | 18.8698   | 24.7582   | 27.9643  | 30.8048    | (232)  |
| Lighting                                                                                             | -53.1313 | -73.2472 | -102.9542 | -113.0731 | -119.6653 | -110.8385 | -109.4153 | -104.3660 | -95.1633  | -82.4447  | -57.8000 | -46.1279   | (233a) |
| Electricity generated by PVs (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) |
| (233a)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 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     | (235c) |
| (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     | (235b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | -35.2330 | -73.4663 | -144.8665 | -215.9569 | -284.0367 | -284.8965 | -281.5856 | -239.1330 | -176.2056 | -104.5604 | -46.8684 | -27.9143   | (233b) |
| (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     | (234b) |
| 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     | (235b) |
| (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     | (235d) |
| Electricity generated by PVs (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     | (235d) |
| (233b)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) |
| 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     | (235d) |
| (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     | (235d) |
| 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     | (235d) |
| (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     | (235d) |
| 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) |
| (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                                                                   |          |          |           |           |           |           |           |           |           |           |          | 4273.8677  | (211)  |
| Space heating fuel - main system 2                                                                   |          |          |           |           |           |           |           |           |           |           |          | 0.0000     | (213)  |
| Space heating fuel - secondary                                                                       |          |          |           |           |           |           |           |           |           |           |          | 0.0000     | (215)  |
| Efficiency of water heater                                                                           |          |          |           |           |           |           |           |           |           |           |          | 79.8000    | (216)  |
| Water heating fuel used                                                                              |          |          |           |           |           |           |           |           |           |           |          | 3051.2997  | (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)                                                  |          |          |           |           |           |           |           |           |           |           |          | 241.8894   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |           |           |           |           |           |           |           |           |          |            |        |
| PV generation                                                                                        |          |          |           |           |           |           |           |           |           |           |          | -2982.9500 | (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                                                                  |          |          |           |           |           |           |           |           |           |           |          | 4670.1068  | (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                 | 4273.8677          | 0.2100                        | 897.5122 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 3051.2997          | 0.2100                        | 640.7729 (264)           |
| Space and water heating                       |                    |                               | 1538.2852 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 241.8894           | 0.1443                        | 34.9121 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -1068.2268         | 0.1351                        | -144.3010                |
| PV Unit electricity exported                  | -1914.7231         | 0.1261                        | -241.4741                |
| Total                                         |                    |                               | -385.7751 (269)          |
| Total CO2, kg/year                            |                    |                               | 1199.3514 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 11.3800 (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               | 4273.8677          | 1.1300                              | 4829.4705 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 3051.2997          | 1.1300                              | 3447.9687 (278)            |
| Space and water heating                     |                    |                                     | 8277.4392 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 241.8894           | 1.5338                              | 371.0180 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -1068.2268         | 1.4993                              | -1601.5685                 |
| PV Unit electricity exported                | -1914.7231         | 0.4629                              | -886.3945                  |
| Total                                       |                    |                                     | -2487.9630 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 6290.5949 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 59.7100 (287)              |