# Full SAP Calculation Printout

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|---|---|---|---|
| Property Reference | F1 | Issued on Date | 02/10/2024 |
| Assessment Reference | F1 | Prop Type Ref | F1 |
| Property | F1 | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 83 B | DER | 16.44 | TER | 16.12 |
| Environmental | 86 B | % DER < TER | | | -1.99 |
| $CO_2$ Emissions (t/year) | 1.37 | DFEE | 40.63 | TFEE | 50.87 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 20.12 |
| % DPER < TPER | -5.45 | DPER | 90.87 | TPER | 86.17 |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Matthew Stainrod | Assessor ID | AU83-0001 |
| Client | | | |

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

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## 1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 90.4500 (1b) | x | 2.5000 (2b) | = | 226.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 90.4500 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 226.1250 | (5) |

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## 2. Ventilation rate

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| | | 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 | | 2 * 10 = | 20.0000 (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) = | | 20.0000 / (5) = | 0.0884 (8) |
| Pressure test | | | Yes |
| Pressure Test Method | | | Blower Door |
| Measured/design AP50 | | | 5.0000 (17) |
| Infiltration rate | | | 0.3384 (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) = | | 0.2877 (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 | 0.3668 | 0.3596 | 0.3524 | 0.3164 | 0.3093 | 0.2733 | 0.2733 | 0.2661 | 0.2877 | 0.3093 | 0.3236 | 0.3380 | (22b) |
| Effective ac | 0.5673 | 0.5647 | 0.5621 | 0.5501 | 0.5478 | 0.5373 | 0.5373 | 0.5354 | 0.5414 | 0.5478 | 0.5524 | 0.5571 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 22.5500 | 1.1450 | 25.8206 | | | (27) |
| External Wall | 92.0500 | 22.5500 | 69.5000 | 0.1500 | 10.4250 | 9.0000 | 625.5000 | (29a) |
| Communal Wall | 39.6500 | 2.1000 | 37.5500 | 0.1500 | 5.6325 | 9.0000 | 337.9500 | (29a) |
| External Roof | 90.4500 | | 90.4500 | 0.1000 | 9.0450 | 9.0000 | 814.0500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 222.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 53.0231 | | | (33) |
| Party Wall | | | 18.8500 | 0.0000 | 0.0000 | 20.0000 | 377.0000 | (32) |
| Party Floor | | | 90.4500 | | | 40.0000 | 3618.0000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6672.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 73.7700 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 11.1075 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 64.1306 (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 42.3302 | 42.1353 | 41.9443 | 41.0469 | 40.8790 | 40.0974 | 40.0974 | 39.9526 | 40.3984 | 40.8790 | 41.2186 | 41.5737 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 106.4609 | 106.2659 | 106.0749 | 105.1775 | 105.0096 | 104.2280 | 104.2280 | 104.0832 | 104.5290 | 105.0096 | 105.3492 | 105.7043 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 105.1767 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1770 | 1.1749 | 1.1727 | 1.1628 | 1.1610 | 1.1523 | 1.1523 | 1.1507 | 1.1557 | 1.1610 | 1.1647 | 1.1686 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1628 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6318 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 93.9770 | 92.5647 | 90.5067 | 86.5691 | 83.6633 | 80.4227 | 78.5808 | 80.6232 | 82.8621 | 86.3414 | 90.3636 | 93.6169 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29.5146 | 29.0763 | 28.4590 | 27.3209 | 26.4687 | 25.5237 | 25.0133 | 25.6262 | 26.2936 | 27.3048 | 28.4663 | 29.4148 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 41.5826 | 40.0705 | 38.5584 | 37.0463 | 35.5342 | 34.0221 | 34.0221 | 35.5342 | 37.0463 | 38.5584 | 40.0705 | 41.5826 (42c) |

Average daily hot water use (litres/day) 151.8107 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 165.0742 | 161.7115 | 157.5241 | 150.9363 | 145.6662 | 139.9685 | 137.6162 | 141.7836 | 146.2020 | 152.2046 | 158.9004 | 164.6143 | (44) |
| Energy conte | 261.4371 | 230.2750 | 242.1087 | 206.6243 | 196.0946 | 172.1076 | 166.4348 | 175.5577 | 180.2816 | 206.5402 | 226.3828 | 257.7463 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2521.5907 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 39.2156 | 34.5412 | 36.3163 | 30.9936 | 29.4142 | 25.8161 | 24.9652 | 26.3337 | 27.0422 | 30.9810 | 33.9574 | 38.6619 | (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 | | | | | | | | | | | | | |
| | 312.3960 | 276.3024 | 293.0676 | 255.9393 | 247.0536 | 221.4227 | 217.3937 | 226.5166 | 229.5967 | 257.4991 | 275.6978 | 308.7052 | (62) |
| WWHRS | -26.7321 | -23.6421 | -24.7567 | -20.4995 | -19.1048 | -16.3481 | -15.3237 | -16.2953 | -16.9144 | -19.9402 | -22.5898 | -26.2371 | (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 | | | | | | | | | | | | | |
| | 285.6639 | 252.6602 | 268.3109 | 235.4398 | 227.9488 | 205.0746 | 202.0700 | 210.2214 | 212.6823 | 237.5589 | 253.1080 | 282.4681 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2873.2070 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2873 | (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 | | | | | | | | | | | | | |
| | 99.6676 | 88.0733 | 93.2409 | 81.0313 | 77.9412 | 69.5546 | 68.0793 | 71.1127 | 72.2724 | 81.4143 | 87.6010 | 98.4404 | (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 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 121.0036 | 133.9683 | 121.0036 | 125.0371 | 121.0036 | 125.0371 | 121.0036 | 121.0036 | 125.0371 | 121.0036 | 125.0371 | 121.0036 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 239.9032 | 242.3926 | 236.1193 | 222.7642 | 205.9057 | 190.0611 | 179.4759 | 176.9865 | 183.2598 | 196.6149 | 213.4734 | 229.3180 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | (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) | | | | | | | | | | | | | |
| | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 133.9618 | 131.0614 | 125.3237 | 112.5435 | 104.7597 | 96.6036 | 91.5044 | 95.5815 | 100.3783 | 109.4279 | 121.6681 | 132.3123 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 560.3460 | 572.8998 | 547.9241 | 525.8222 | 497.1464 | 474.1791 | 454.4614 | 456.0491 | 471.1526 | 492.5239 | 525.6560 | 548.1114 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 4.1200 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 13.3888 | (74) |
| East | 5.1100 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 30.6719 | (76) |
| West | 13.3200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 79.9509 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 124.0115 | 241.9882 | 399.8605 | 589.5995 | 731.0652 | 752.7830 | 714.8257 | 607.8553 | 466.7623 | 287.2363 | 154.4504 | 102.1323 | (83) |
| Total gains | 684.3576 | 814.8880 | 947.7846 | 1115.4217 | 1228.2116 | 1226.9621 | 1169.2871 | 1063.9044 | 937.9149 | 779.7601 | 680.1064 | 650.2437 | (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 | 17.4099 | 17.4418 | 17.4732 | 17.6223 | 17.6505 | 17.7829 | 17.7829 | 17.8076 | 17.7316 | 17.6505 | 17.5936 | 17.5345 | |
| alpha | 2.1607 | 2.1628 | 2.1649 | 2.1748 | 2.1767 | 2.1855 | 2.1855 | 2.1872 | 2.1821 | 2.1767 | 2.1729 | 2.1690 | |
| util living area | | | | | | | | | | | | | |
| | 0.9178 | 0.8836 | 0.8284 | 0.7289 | 0.6039 | 0.4672 | 0.3597 | 0.4032 | 0.5922 | 0.7909 | 0.8891 | 0.9252 | (86) |
| MIT | 17.9560 | 18.3744 | 19.0031 | 19.7761 | 20.3742 | 20.7491 | 20.8985 | 20.8666 | 20.5572 | 19.7332 | 18.7126 | 17.8806 | (87) |
| Th 2 | 19.9384 | 19.9402 | 19.9419 | 19.9499 | 19.9514 | 19.9583 | 19.9583 | 19.9596 | 19.9556 | 19.9514 | 19.9483 | 19.9452 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9082 | 0.8704 | 0.8091 | 0.6990 | 0.5603 | 0.4068 | 0.2840 | 0.3248 | 0.5323 | 0.7599 | 0.8743 | 0.9164 | (89) |
| MIT 2 | 17.1762 | 17.5846 | 18.1941 | 18.9312 | 19.4763 | 19.7997 | 19.9103 | 19.8930 | 19.6544 | 18.9136 | 17.9290 | 17.1068 | (90) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4270 | (91) |
| MIT | 17.5091 | 17.9218 | 18.5395 | 19.2919 | 19.8597 | 20.2051 | 20.3322 | 20.3087 | 20.0399 | 19.2636 | 18.2636 | 17.4372 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.3591 | 17.7718 | 18.3895 | 19.1419 | 19.7097 | 20.0551 | 20.1822 | 20.1587 | 19.8899 | 19.1136 | 18.1136 | 17.2872 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8771 | 0.8363 | 0.7750 | 0.6730 | 0.5495 | 0.4127 | 0.3009 | 0.3405 | 0.5282 | 0.7306 | 0.8412 | 0.8866 | (94) |
| Useful gains | 600.2731 | 681.5019 | 734.5590 | 750.6867 | 674.8915 | 506.4050 | 351.8338 | 362.2901 | 495.4452 | 569.7260 | 572.1015 | 576.4828 | (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 | 1390.2874 | 1367.8353 | 1261.1796 | 1077.2210 | 841.0922 | 568.5715 | 373.3681 | 391.2186 | 605.2104 | 894.0044 | 1160.2711 | 1383.3746 | (97) |
| Space heating kWh | 587.7707 | 461.2160 | 391.8057 | 235.1047 | 123.6534 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 241.2632 | 423.4821 | 600.3275 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3064.6234 | |
| 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 | 587.7707 | 461.2160 | 391.8057 | 235.1047 | 123.6534 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 241.2632 | 423.4821 | 600.3275 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3064.6234 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.8820 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 %) | | | | | | | | | | | | 88.9000 | (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 | 587.7707 | 461.2160 | 391.8057 | 235.1047 | 123.6534 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 241.2632 | 423.4821 | 600.3275 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 661.1594 | 518.8032 | 440.7264 | 264.4597 | 139.0926 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 271.3872 | 476.3578 | 675.2841 | (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 | 285.6639 | 252.6602 | 268.3109 | 235.4398 | 227.9488 | 205.0746 | 202.0700 | 210.2214 | 212.6823 | 237.5589 | 253.1080 | 282.4681 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.8914 | 85.6533 | 85.1915 | 84.3784 | 83.1281 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.4146 | 85.4754 | 85.9545 | (217) |
| Fuel for water heating, kWh/month | 332.5872 | 294.9801 | 314.9503 | 279.0286 | 274.2138 | 255.3856 | 251.6438 | 261.7950 | 264.8597 | 281.4191 | 296.1178 | 328.6252 | (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 | 25.1422 | 20.1700 | 18.1608 | 13.3054 | 10.2775 | 8.3968 | 9.3755 | 12.1866 | 15.8292 | 20.7687 | 23.4582 | 25.8409 | (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) | | | | | | | | | | | | | |
| (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 | 3447.2704 | (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 | 3435.6061 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 202.9116 | (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 | 7171.7881 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3447.2704 | 0.2100 | 723.9268 | (261) |

| | | | | |
|---|---|---|---|---|
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3435.6061 | 0.2100 | 721.4773 | (264) |
| Space and water heating | | | 1445.4041 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 202.9116 | 0.1443 | 29.2864 | (268) |
| Total CO2, kg/year | | | 1486.6197 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 16.4400 | (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 | 3447.2704 | 1.1300 | 3895.4155 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3435.6061 | 1.1300 | 3882.2349 | (278) |
| Space and water heating | | | 7777.6504 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 202.9116 | 1.5338 | 311.2326 | (282) |
| Total Primary energy kWh/year | | | 8218.9838 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 90.8700 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 90.4500 | (1b) | x 2.5000 | (2b) = | 226.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 90.4500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 226.1250 | (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) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1327 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3827 | (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) = | 0.3253 | (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 | 0.4147 | 0.4066 | 0.3985 | 0.3578 | 0.3497 | 0.3090 | 0.3090 | 0.3009 | 0.3253 | 0.3497 | 0.3659 | 0.3822 | (22b) |
| Effective ac | 0.5860 | 0.5827 | 0.5794 | 0.5640 | 0.5611 | 0.5477 | 0.5477 | 0.5453 | 0.5529 | 0.5611 | 0.5670 | 0.5730 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 20.5200 | 1.1450 | 23.4962 | | | (27) |
| External Wall | 92.0500 | 20.5200 | 71.5300 | 0.1800 | 12.8754 | | | (29a) |
| Communal Wall | 39.6500 | 2.1000 | 37.5500 | 0.1800 | 6.7590 | | | (29a) |
| External Roof | 90.4500 | | 90.4500 | 0.1100 | 9.9495 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 222.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 55.1801 | | | (33) |
| Party Wall | | | 18.8500 | 0.0000 | 0.0000 | | | (32) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 73.7700 | (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 13.8000 | 0.0500 | 0.6900 |
| E3 | Sill | 9.6000 | 0.0500 | 0.4800 |
| E4 | Jamb | 44.8000 | 0.0500 | 2.2400 |
| E7 | Party floor between dwellings (in blocks of flats) | 46.0400 | 0.0700 | 3.2228 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 6.6400 | 0.0200 | 0.1328 |
| E14 | Flat roof | 15.8600 | 0.0800 | 1.2688 |
| E15 | Flat roof with parapet | 36.8200 | 0.5600 | 20.6192 |
| E16 | Corner (normal) | 20.0000 | 0.0900 | 1.8000 |

| | | | | |
|---|---|---|---|---|
| E17 Corner (inverted - internal area greater than external area) | 10.0000 | -0.0900 | -0.9000 | |
| E18 Party wall between dwellings | 2.5000 | 0.0600 | 0.1500 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 7.5400 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 7.5400 | 0.1200 | 0.9048 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.6084 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 85.7885 (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 | 43.7277 | 43.4786 | 43.2343 | 42.0871 | 41.8724 | 40.8732 | 40.8732 | 40.6882 | 41.2581 | 41.8724 | 42.3066 | 42.7606 | (38) |
| Heat transfer coeff | 129.5162 | 129.2670 | 129.0228 | 127.8756 | 127.6609 | 126.6617 | 126.6617 | 126.4767 | 127.0466 | 127.6609 | 128.0951 | 128.5491 | (39) |

Average = Sum(39)m / 12 = 127.8745

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4319 | 1.4292 | 1.4265 | 1.4138 | 1.4114 | 1.4004 | 1.4004 | 1.3983 | 1.4046 | 1.4114 | 1.4162 | 1.4212 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4138 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6318 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 68.3469 | 67.3198 | 65.8231 | 62.9594 | 60.8460 | 58.4892 | 57.1497 | 58.6350 | 60.2633 | 62.7938 | 65.7190 | 68.0850 | (42a) |
| Hot water usage for baths | 29.5146 | 29.0763 | 28.4590 | 27.3209 | 26.4687 | 25.5237 | 25.0133 | 25.6262 | 26.2936 | 27.3048 | 28.4663 | 29.4148 | (42b) |
| Hot water usage for other uses | 41.5826 | 40.0705 | 38.5584 | 37.0463 | 35.5342 | 34.0221 | 34.0221 | 35.5342 | 37.0463 | 38.5584 | 40.0705 | 41.5826 | (42c) |

Average daily hot water use (litres/day) 128.1806 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.4441 | 136.4665 | 132.8405 | 127.3265 | 122.8489 | 118.0351 | 116.1850 | 119.7955 | 123.6032 | 128.6569 | 134.2558 | 139.0824 | (44) |
| Energy conte | 220.8453 | 194.3265 | 204.1708 | 174.3037 | 165.3782 | 145.1379 | 140.5157 | 148.3318 | 152.4151 | 174.5862 | 191.2720 | 217.7695 | (45) |

Energy content (annual) Total = Sum(45)m = 2129.0529

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 33.1268 | 29.1490 | 30.6256 | 26.1456 | 24.8067 | 21.7707 | 21.0774 | 22.2498 | 22.8623 | 26.1879 | 28.6908 | 32.6654 | (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 | 271.8043 | 240.3539 | 255.1297 | 223.6187 | 216.3371 | 194.4529 | 191.4746 | 199.2907 | 201.7302 | 225.5451 | 240.5871 | 268.7284 | (62) |
| WWHRS | -31.2453 | -27.6336 | -28.9364 | -23.9604 | -22.3303 | -19.1082 | -17.9109 | -19.0464 | -19.7701 | -23.3067 | -26.4037 | -30.6667 | (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 | 240.5589 | 212.7203 | 226.1934 | 199.6583 | 194.0069 | 175.3448 | 173.5638 | 180.2443 | 181.9601 | 202.2384 | 214.1834 | 238.0617 | (64) |

Total per year (kWh/year) = Sum(64)m = 2438.7342 (64)

12Total per year (kWh/year) 2439 (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 | 86.1708 | 76.1204 | 80.6265 | 70.2847 | 67.7280 | 60.5871 | 59.4612 | 62.0601 | 63.0068 | 70.7896 | 75.9267 | 85.1481 | (65) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 120.9794 | 133.9414 | 120.9794 | 125.0120 | 120.9794 | 125.0120 | 120.9794 | 120.9794 | 125.0120 | 120.9794 | 125.0120 | 120.9794 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 239.9032 | 242.3926 | 236.1193 | 222.7642 | 205.9057 | 190.0611 | 179.4759 | 176.9865 | 183.2598 | 196.6149 | 213.4734 | 229.3180 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | (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) | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | (71) |
| Water heating gains (Table 5) | 115.8210 | 113.2744 | 108.3690 | 97.6177 | 91.0322 | 84.1488 | 79.9210 | 83.4141 | 87.5094 | 95.1474 | 105.4538 | 114.4463 | (72) |
| Total internal gains | 542.1810 | 555.0860 | 530.9451 | 510.8713 | 483.3947 | 461.6993 | 442.8537 | 443.8573 | 458.2587 | 478.2191 | 509.4166 | 530.2212 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 3.7500 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 12.1864 | (74) |
| East | 4.6500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 27.9108 | (76) |
| West | 12.1200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 72.7481 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 112.8453 | 220.1990 | 363.8564 | 536.5124 | 665.2427 | 685.0061 | 650.4658 | 553.1252 | 424.7346 | 261.3728 | 140.5433 | 92.9362 | (83) |
| Total gains | 655.0263 | 775.2849 | 894.8015 | 1047.3837 | 1148.6374 | 1146.7054 | 1093.3196 | 996.9825 | 882.9933 | 739.5919 | 649.9599 | 623.1573 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 14.3107 | 14.3383 | 14.3655 | 14.4943 | 14.5187 | 14.6332 | 14.6332 | 14.6547 | 14.5889 | 14.5187 | 14.4695 | 14.4184 | |
| alpha | 1.9540 | 1.9559 | 1.9577 | 1.9663 | 1.9679 | 1.9755 | 1.9755 | 1.9770 | 1.9726 | 1.9679 | 1.9646 | 1.9612 | |
| util living area | 0.9304 | 0.9039 | 0.8612 | 0.7812 | 0.6740 | 0.5447 | 0.4335 | 0.4787 | 0.6612 | 0.8300 | 0.9077 | 0.9362 | (86) |
| MIT | 17.2796 | 17.6904 | 18.3595 | 19.2417 | 20.0027 | 20.5490 | 20.7978 | 20.7463 | 20.2913 | 19.2768 | 18.1312 | 17.2094 | (87) |
| Th 2 | 19.7390 | 19.7411 | 19.7431 | 19.7528 | 19.7546 | 19.7631 | 19.7631 | 19.7646 | 19.7598 | 19.7546 | 19.7509 | 19.7471 | (88) |
| util rest of house | 0.9211 | 0.8912 | 0.8425 | 0.7508 | 0.6258 | 0.4708 | 0.3328 | 0.3775 | 0.5937 | 0.7991 | 0.8934 | 0.9277 | (89) |
| MIT 2 | 15.5066 | 16.0158 | 16.8420 | 17.9154 | 18.8082 | 19.4124 | 19.6500 | 19.6132 | 19.1621 | 17.9879 | 16.5773 | 15.4213 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4270 | (91) |
| MIT | 16.2636 | 16.7308 | 17.4900 | 18.4817 | 19.3182 | 19.8977 | 20.1401 | 20.0970 | 19.6443 | 18.5382 | 17.2408 | 16.1848 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.2636 | 16.7308 | 17.4900 | 18.4817 | 19.3182 | 19.8977 | 20.1401 | 20.0970 | 19.6443 | 18.5382 | 17.2408 | 16.1848 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8835 | 0.8492 | 0.7986 | 0.7134 | 0.6067 | 0.4795 | 0.3654 | 0.4067 | 0.5865 | 0.7606 | 0.8529 | 0.8917 | (94) |
| Useful gains | 578.7293 | 658.3630 | 714.5627 | 747.1555 | 696.8442 | 549.8421 | 399.4766 | 405.4935 | 517.8908 | 562.5651 | 554.3697 | 555.6477 | (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 | 1549.4829 | 1529.3327 | 1417.9542 | 1225.2632 | 972.5484 | 671.0153 | 448.3940 | 467.5859 | 704.3796 | 1013.4039 | 1298.9881 | 1540.6368 | (97) |
| Space heating kWh | 722.2406 | 585.2916 | 523.3233 | 344.2375 | 205.1239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 335.4241 | 536.1252 | 732.8319 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3984.5983 | |
| 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 | 722.2406 | 585.2916 | 523.3233 | 344.2375 | 205.1239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 335.4241 | 536.1252 | 732.8319 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3984.5983 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 44.0530 | (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 | 722.2406 | 585.2916 | 523.3233 | 344.2375 | 205.1239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 335.4241 | 536.1252 | 732.8319 | (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) | 781.6457 | 633.4325 | 566.3672 | 372.5515 | 221.9956 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 363.0131 | 580.2221 | 793.1081 | (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 | 240.5589 | 212.7203 | 226.1934 | 199.6583 | 194.0069 | 175.3448 | 173.5638 | 180.2443 | 181.9601 | 202.2384 | 214.1834 | 238.0617 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.5831 | 86.4325 | 86.1166 | 85.5371 | 84.5011 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.4574 | 86.2627 | 86.6252 | (217) |
| Fuel for water heating, kWh/month | 277.8358 | 246.1115 | 262.6593 | 233.4171 | 229.5910 | 218.3621 | 216.1442 | 224.4637 | 226.6004 | 236.6541 | 248.2919 | 274.8181 | (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 | 25.1371 | 20.1659 | 18.1572 | 13.3027 | 10.2754 | 8.3951 | 9.3736 | 12.1841 | 15.8260 | 20.7645 | 23.4535 | 25.8358 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -16.9632 | -25.5837 | -39.3051 | -47.3277 | -53.8200 | -51.2511 | -50.6151 | -46.3808 | -39.4405 | -30.5816 | -19.2280 | -14.4770 | (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 | -5.1095 | -11.0643 | -22.5988 | -34.8617 | -47.0218 | -47.6006 | -47.0541 | -39.4228 | -28.3456 | -16.1310 | -6.9174 | -4.0182 | (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 | 4312.3358 | (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 | 2894.9491 | (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) | 202.8710 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -745.1196 | (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 | 6751.0362 | (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 | 4312.3358 | 0.2100 | 905.5905 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2894.9491 | 0.2100 | 607.9393 | (264) |
| Space and water heating | | | 1513.5298 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 202.8710 | 0.1443 | 29.2806 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -434.9738 | 0.1332 | -57.9412 | |
| PV Unit electricity exported | -310.1459 | 0.1251 | -38.8038 | |
| Total | | | -96.7451 | (269) |
| Total CO2, kg/year | | | 1457.9946 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.1200 | (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 | 4312.3358 | 1.1300 | 4872.9395 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2894.9491 | 1.1300 | 3271.2925 | (278) |
| Space and water heating | | | 8144.2319 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 202.8710 | 1.5338 | 311.1703 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -434.9738 | 1.4922 | -649.0805 | |
| PV Unit electricity exported | -310.1459 | 0.4592 | -142.4247 | |
| Total | | | -791.5052 | (283) |
| Total Primary energy kWh/year | | | 7793.9978 | (286) |
| Target Primary Energy Rate (TPER) | | | 86.1700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F1 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F1 | **Prop Type Ref** | F1 |
| **Property** | F1 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 83 B | **DER** | 16.44 | **TER** | 16.12 |
| **Environmental** | 86 B | **% DER < TER** | | | -1.99 |
| **$CO_2$ Emissions (t/year)** | 1.37 | **DFEE** | 40.63 | **TFEE** | 50.87 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 20.12 |
| **% DPER < TPER** | -5.45 | **DPER** | 90.87 | **TPER** | 86.17 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 90.4500 | (1b) | x 2.5000 | (2b) = | 226.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 90.4500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 226.1250 | (5) |

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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) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1327 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3827 | (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) = | 0.3253 | (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 | 0.4147 | 0.4066 | 0.3985 | 0.3578 | 0.3497 | 0.3090 | 0.3090 | 0.3009 | 0.3253 | 0.3497 | 0.3659 | 0.3822 | (22b) |

| | | |
|---|---|---|
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.0000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 0.0000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5860 | 0.5827 | 0.5794 | 0.5640 | 0.5611 | 0.5477 | 0.5477 | 0.5453 | 0.5529 | 0.5611 | 0.5670 | 0.5730 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 22.5500 | 1.1450 | 25.8206 | | | (27) |
| External Wall | 92.0500 | 22.5500 | 69.5000 | 0.1500 | 10.4250 | 9.0000 | 625.5000 | (29a) |
| Communal Wall | 39.6500 | 2.1000 | 37.5500 | 0.1500 | 5.6325 | 9.0000 | 337.9500 | (29a) |
| External Roof | 90.4500 | | 90.4500 | 0.1000 | 9.0450 | 9.0000 | 814.0500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 222.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 53.0231 | | | (33) |
| Party Wall | | | 18.8500 | 0.0000 | 0.0000 | 20.0000 | 377.0000 | (32) |
| Party Floor | | | 90.4500 | | | 40.0000 | 3618.0000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6672.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 73.7700 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 11.1075 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 64.1306 (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 | 43.7277 | 43.4786 | 43.2343 | 42.0871 | 41.8724 | 40.8732 | 40.8732 | 40.6882 | 41.2581 | 41.8724 | 42.3066 | 42.7606 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 107.8583 | 107.6092 | 107.3649 | 106.2177 | 106.0030 | 105.0038 | 105.0038 | 104.8188 | 105.3887 | 106.0030 | 106.4373 | 106.8912 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 106.2167 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1925 | 1.1897 | 1.1870 | 1.1743 | 1.1720 | 1.1609 | 1.1609 | 1.1589 | 1.1652 | 1.1720 | 1.1768 | 1.1818 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1743 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.6318 | (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 | | | | | | | | | | | | | |
| | 29.5146 | 29.0763 | 28.4590 | 27.3209 | 26.4687 | 25.5237 | 25.0133 | 25.6262 | 26.2936 | 27.3048 | 28.4663 | 29.4148 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 41.5826 | 40.0705 | 38.5584 | 37.0463 | 35.5342 | 34.0221 | 34.0221 | 35.5342 | 37.0463 | 38.5584 | 40.0705 | 41.5826 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 65.1670 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 71.0972 | 69.1468 | 67.0174 | 64.3672 | 62.0029 | 59.5458 | 59.0354 | 61.1604 | 63.3399 | 65.8632 | 68.5368 | 70.9974 | (44) |
| Energy conte | 112.6006 | 98.4641 | 103.0033 | 88.1155 | 83.4678 | 73.2185 | 71.3982 | 75.7294 | 78.1044 | 89.3757 | 97.6433 | 111.1648 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1082.2854 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 95.7105 | 83.6945 | 87.5528 | 74.8981 | 70.9476 | 62.2357 | 60.6885 | 64.3700 | 66.3888 | 75.9693 | 82.9968 | 94.4901 | (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 | | | | | | | | | | | | | |
| | 95.7105 | 83.6945 | 87.5528 | 74.8981 | 70.9476 | 62.2357 | 60.6885 | 64.3700 | 66.3888 | 75.9693 | 82.9968 | 94.4901 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 919.9426 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 920 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 54.7345 | 48.7689 | 53.2537 | 50.8194 | 51.7730 | 49.3864 | 51.0326 | 51.7730 | 50.8194 | 53.2537 | 52.2524 | 54.7345 | (64a) |
| | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | 622.6014 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 37.6112 | 33.1158 | 35.2016 | 31.4294 | 30.6802 | 27.9055 | 27.9303 | 29.0357 | 29.3020 | 32.3058 | 33.8123 | 37.3061 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 121.0036 | 133.9683 | 121.0036 | 125.0371 | 121.0036 | 125.0371 | 121.0036 | 121.0036 | 125.0371 | 121.0036 | 125.0371 | 121.0036 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 239.9032 | 242.3926 | 236.1193 | 222.7642 | 205.9057 | 190.0611 | 179.4759 | 176.9865 | 183.2598 | 196.6149 | 213.4734 | 229.3180 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | (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) | | | | | | | | | | | | | |
| | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 50.5527 | 49.2795 | 47.3140 | 43.6519 | 41.2368 | 38.7577 | 37.5407 | 39.0265 | 40.6973 | 43.4217 | 46.9615 | 50.1427 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 473.9370 | 488.1179 | 466.9144 | 453.9306 | 430.6235 | 416.3333 | 400.4977 | 399.4941 | 411.4716 | 423.5177 | 447.9494 | 462.9417 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 4.1200 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 13.3888 | (74) |
| East | 5.1100 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 30.6719 | (76) |
| West | 13.3200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 79.9509 | (80) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 124.0115 | 241.9882 | 399.8605 | 589.5995 | 731.0652 | 752.7830 | 714.8257 | 607.8553 | 466.7623 | 287.2363 | 154.4504 | 102.1323 | (83) |
| Total gains | 597.9485 | 730.1061 | 866.7749 | 1043.5301 | 1161.6887 | 1169.1163 | 1115.3233 | 1007.3494 | 878.2338 | 710.7540 | 602.3998 | 565.0741 | (84) |

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## 7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 17.1843 | 17.2241 | 17.2633 | 17.4498 | 17.4851 | 17.6515 | 17.6515 | 17.6826 | 17.5870 | 17.4851 | 17.4138 | 17.3398 | |
| alpha | 2.1456 | 2.1483 | 2.1509 | 2.1633 | 2.1657 | 2.1768 | 2.1768 | 2.1788 | 2.1725 | 2.1657 | 2.1609 | 2.1560 | |
| util living area | | | | | | | | | | | | | |
| | 0.9353 | 0.9032 | 0.8506 | 0.7517 | 0.6265 | 0.4864 | 0.3763 | 0.4232 | 0.6182 | 0.8171 | 0.9097 | 0.9418 | (86) |
| MIT | 17.7324 | 18.1737 | 18.8392 | 19.6727 | 20.3153 | 20.7244 | 20.8872 | 20.8510 | 20.5099 | 19.6160 | 18.5336 | 17.6612 | (87) |
| Th 2 | 19.9260 | 19.9282 | 19.9304 | 19.9406 | 19.9425 | 19.9514 | 19.9514 | 19.9531 | 19.9480 | 19.9425 | 19.9386 | 19.9346 | (88) |
| util rest of house | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.9274 | 0.8918 | 0.8329 | 0.7228 | 0.5828 | 0.4245 | 0.2975 | 0.3419 | 0.5581 | 0.7883 | 0.8970 | 0.9347 | (89) |
| MIT 2 | 16.9508 | 17.3837 | 18.0319 | 18.8315 | 19.4207 | 19.7765 | 19.8979 | 19.8783 | 19.6123 | 18.8016 | 17.7512 | 16.8860 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4270 | (91) |
| MIT | 17.2845 | 17.7210 | 18.3766 | 19.1907 | 19.8027 | 20.1812 | 20.3203 | 20.2936 | 19.9955 | 19.1493 | 18.0853 | 17.2170 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.2845 | 17.7210 | 18.3766 | 19.1907 | 19.8027 | 20.1812 | 20.3203 | 20.2936 | 19.9955 | 19.1493 | 18.0853 | 17.2170 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9009 | 0.8613 | 0.8016 | 0.6996 | 0.5766 | 0.4387 | 0.3262 | 0.3695 | 0.5610 | 0.7625 | 0.8681 | 0.9096 | (94) |
| Useful gains | 538.6924 | 628.8581 | 694.8173 | 730.0345 | 669.7993 | 512.8914 | 363.8234 | 372.1868 | 492.7244 | 541.9462 | 522.9648 | 514.0112 | (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 | | | | | | | | | | | | | |
| | 1400.4885 | 1379.6597 | 1275.1313 | 1093.0530 | 858.9077 | 586.0506 | 390.6490 | 408.1241 | 621.3230 | 906.2560 | 1169.2439 | 1391.4045 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 641.1763 | 504.5387 | 431.7536 | 261.3733 | 140.6966 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 271.0464 | 465.3210 | 652.7806 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3368.6866 | |
| 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 | | | | | | | | | | | | | |
| | 641.1763 | 504.5387 | 431.7536 | 261.3733 | 140.6966 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 271.0464 | 465.3210 | 652.7806 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3368.6866 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 37.2436 | (99) |

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8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 987.0360 | 777.0283 | 796.6228 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7775 | 0.8291 | 0.7958 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 767.4500 | 644.2576 | 633.9598 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1318.9539 | 1258.4251 | 1134.5952 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 397.0828 | 456.9406 | 372.4728 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 99.2707 | 114.2352 | 93.1182 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 306.6241 | (107) |
| Energy for space heating | | | | | | | | | | | | 37.2436 | (99) |
| Energy for space cooling | | | | | | | | | | | | 3.3900 | (108) |
| Total | | | | | | | | | | | | 40.6336 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 40.6 | (109) |

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

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 90.4500 | (1b) | x 2.5000 | (2b) = | 226.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 90.4500 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 226.1250 | (5) |

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2. Ventilation rate

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| | | 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) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | | 30.0000 / (5) = | 0.1327 (8) |
| Pressure test | | | Yes |
| Pressure Test Method | | | Blower Door |
| Measured/design AP50 | | | 5.0000 (17) |
| Infiltration rate | | | 0.3827 (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) = | | 0.3253 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.4147 | 0.4066 | 0.3985 | 0.3578 | 0.3497 | 0.3090 | 0.3090 | 0.3009 | 0.3253 | 0.3497 | 0.3659 | 0.3822 (22b) |

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5860 | 0.5827 | 0.5794 | 0.5640 | 0.5611 | 0.5477 | 0.5477 | 0.5453 | 0.5529 | 0.5611 | 0.5670 | 0.5730 (25) |

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## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 20.5200 | 1.1450 | 23.4962 | | | (27) |
| External Wall | 92.0500 | 20.5200 | 71.5300 | 0.1800 | 12.8754 | | | (29a) |
| Communal Wall | 39.6500 | 2.1000 | 37.5500 | 0.1800 | 6.7590 | | | (29a) |
| External Roof | 90.4500 | | 90.4500 | 0.1100 | 9.9495 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 222.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 55.1801 | | | (33) |
| Party Wall | | | 18.8500 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 73.7700 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 13.8000 | 0.0500 | 0.6900 |
| E3 | Sill | 9.6000 | 0.0500 | 0.4800 |
| E4 | Jamb | 44.8000 | 0.0500 | 2.2400 |
| E7 | Party floor between dwellings (in blocks of flats) | 46.0400 | 0.0700 | 3.2228 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 6.6400 | 0.0200 | 0.1328 |
| E14 | Flat roof | 15.8600 | 0.0800 | 1.2688 |
| E15 | Flat roof with parapet | 36.8200 | 0.5600 | 20.6192 |
| E16 | Corner (normal) | 20.0000 | 0.0900 | 1.8000 |
| E17 | Corner (inverted - internal area greater than external area) | 10.0000 | -0.0900 | -0.9000 |
| E18 | Party wall between dwellings | 2.5000 | 0.0600 | 0.1500 |
| P3 | Party wall - Intermediate floor between dwellings (in blocks of flats) | 7.5400 | 0.0000 | 0.0000 |
| P4 | Party wall - Roof (insulation at ceiling level) | 7.5400 | 0.1200 | 0.9048 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.6084 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 85.7885 (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 | 43.7277 | 43.4786 | 43.2343 | 42.0871 | 41.8724 | 40.8732 | 40.8732 | 40.6882 | 41.2581 | 41.8724 | 42.3066 | 42.7606 | (38) |
| Heat transfer coeff | 129.5162 | 129.2670 | 129.0228 | 127.8756 | 127.6609 | 126.6617 | 126.6617 | 126.4767 | 127.0466 | 127.6609 | 128.0951 | 128.5491 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 127.8745 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4319 | 1.4292 | 1.4265 | 1.4138 | 1.4114 | 1.4004 | 1.4004 | 1.3983 | 1.4046 | 1.4114 | 1.4162 | 1.4212 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4138 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6318 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29.5146 | 29.0763 | 28.4590 | 27.3209 | 26.4687 | 25.5237 | 25.0133 | 25.6262 | 26.2936 | 27.3048 | 28.4663 | 29.4148 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 41.5826 | 40.0705 | 38.5584 | 37.0463 | 35.5342 | 34.0221 | 34.0221 | 35.5342 | 37.0463 | 38.5584 | 40.0705 | 41.5826 (42c) |

Average daily hot water use (litres/day) 65.1670 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 71.0972 | 69.1468 | 67.0174 | 64.3672 | 62.0029 | 59.5458 | 59.0354 | 61.1604 | 63.3399 | 65.8632 | 68.5368 | 70.9974 | (44) |
| Energy conte | 112.6006 | 98.4641 | 103.0033 | 88.1155 | 83.4678 | 73.2185 | 71.3982 | 75.7294 | 78.1044 | 89.3757 | 97.6433 | 111.1648 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1082.2854 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 95.7105 | 83.6945 | 87.5528 | 74.8981 | 70.9476 | 62.2357 | 60.6885 | 64.3700 | 66.3888 | 75.9693 | 82.9968 | 94.4901 | (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 | | | | | | | | | | | | | |
| | 95.7105 | 83.6945 | 87.5528 | 74.8981 | 70.9476 | 62.2357 | 60.6885 | 64.3700 | 66.3888 | 75.9693 | 82.9968 | 94.4901 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 919.9426 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 920 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 54.7345 | 48.7689 | 53.2537 | 50.8194 | 51.7730 | 49.3864 | 51.0326 | 51.7730 | 50.8194 | 53.2537 | 52.2524 | 54.7345 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 622.6014 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 37.6112 | 33.1158 | 35.2016 | 31.4294 | 30.6802 | 27.9055 | 27.9303 | 29.0357 | 29.3020 | 32.3058 | 33.8123 | 37.3061 | (65) |

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## 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 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 120.9794 | 133.9414 | 120.9794 | 125.0120 | 120.9794 | 125.0120 | 120.9794 | 120.9794 | 125.0120 | 120.9794 | 125.0120 | 120.9794 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 239.9032 | 242.3926 | 236.1193 | 222.7642 | 205.9057 | 190.0611 | 179.4759 | 176.9865 | 183.2598 | 196.6149 | 213.4734 | 229.3180 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | (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) | | | | | | | | | | | | | |
| | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 50.5527 | 49.2795 | 47.3140 | 43.6519 | 41.2368 | 38.7577 | 37.5407 | 39.0265 | 40.6973 | 43.4217 | 46.9615 | 50.1427 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 473.9127 | 488.0910 | 466.8901 | 453.9055 | 430.5992 | 416.3082 | 400.4734 | 399.4698 | 411.4465 | 423.4935 | 447.9244 | 462.9175 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 3.7500 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 12.1864 | (74) |
| East | 4.6500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 27.9108 | (76) |
| West | 12.1200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 72.7481 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 112.8453 | 220.1990 | 363.8564 | 536.5124 | 665.2427 | 685.0061 | 650.4658 | 553.1252 | 424.7346 | 261.3728 | 140.5433 | 92.9362 | (83) |
| Total gains | 586.7580 | 708.2900 | 830.7465 | 990.4179 | 1095.8419 | 1101.3143 | 1050.9393 | 952.5950 | 836.1811 | 684.8663 | 588.4677 | 555.8536 | (84) |

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## 7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 14.3107 | 14.3383 | 14.3655 | 14.4943 | 14.5187 | 14.6332 | 14.6332 | 14.6547 | 14.5889 | 14.5187 | 14.4695 | 14.4184 | |
| alpha | 1.9540 | 1.9559 | 1.9577 | 1.9663 | 1.9679 | 1.9755 | 1.9755 | 1.9770 | 1.9726 | 1.9679 | 1.9646 | 1.9612 | |
| util living area | 0.9418 | 0.9164 | 0.8752 | 0.7960 | 0.6893 | 0.5588 | 0.4465 | 0.4942 | 0.6791 | 0.8469 | 0.9210 | 0.9472 | (86) |
| MIT | 17.1435 | 17.5666 | 18.2551 | 19.1696 | 19.9573 | 20.5267 | 20.7864 | 20.7306 | 20.2527 | 19.1952 | 18.0156 | 17.0726 | (87) |
| Th 2 | 19.7390 | 19.7411 | 19.7431 | 19.7528 | 19.7546 | 19.7631 | 19.7631 | 19.7646 | 19.7598 | 19.7546 | 19.7509 | 19.7471 | (88) |
| util rest of house | 0.9339 | 0.9052 | 0.8579 | 0.7667 | 0.6418 | 0.4845 | 0.3440 | 0.3915 | 0.6125 | 0.8181 | 0.9084 | 0.9400 | (89) |
| MIT 2 | 16.2624 | 16.6787 | 17.3529 | 18.2372 | 18.9701 | 19.4712 | 19.6683 | 19.6369 | 19.2590 | 18.2860 | 17.1343 | 16.1973 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4270 | (91) |
| MIT | 16.6386 | 17.0578 | 17.7381 | 18.6353 | 19.3916 | 19.9218 | 20.1457 | 20.1039 | 19.6833 | 18.6742 | 17.5106 | 16.5710 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.6386 | 17.0578 | 17.7381 | 18.6353 | 19.3916 | 19.9218 | 20.1457 | 20.1039 | 19.6833 | 18.6742 | 17.5106 | 16.5710 | (93) |

---

## 8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9058 | 0.8723 | 0.8222 | 0.7353 | 0.6261 | 0.4948 | 0.3778 | 0.4219 | 0.6078 | 0.7864 | 0.8771 | 0.9134 | (94) |
| Useful gains | 531.4748 | 617.8615 | 683.0752 | 728.2308 | 686.1050 | 544.9677 | 396.9973 | 401.8821 | 508.2348 | 538.5980 | 516.1688 | 507.7012 | (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 | 1598.0478 | 1571.5993 | 1449.9722 | 1244.9065 | 981.9141 | 674.0738 | 449.1005 | 468.4559 | 709.3393 | 1030.7584 | 1333.5468 | 1590.2845 | (97) |
| Space heating kWh | 793.5303 | 640.9118 | 570.5714 | 372.0065 | 220.0820 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 366.1673 | 588.5121 | 805.4420 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4357.2234 | |
| 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 | 793.5303 | 640.9118 | 570.5714 | 372.0065 | 220.0820 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 366.1673 | 588.5121 | 805.4420 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4357.2234 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 48.1727 | (99) |

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## 8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1190.6200 | 937.2966 | 961.2227 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.6773 | 0.7377 | 0.6992 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 806.3524 | 691.4372 | 672.0723 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1239.7320 | 1183.1970 | 1070.6220 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 312.0333 | 365.8693 | 296.5210 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 78.0083 | 91.4673 | 74.1302 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 243.6059 | (107) |
| Energy for space heating | | | | | | | | | | | | 48.1727 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.6933 | (108) |
| Total | | | | | | | | | | | | 50.8660 | (109) |
| Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 50.9 | (109) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Property Reference | F1 | Issued on Date | 02/10/2024 |
| Assessment Reference | F1 | Prop Type Ref | F1 |
| Property | F1 | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 83 B | DER | 16.44 | TER | 16.12 |
| Environmental | 86 B | % DER < TER | | | -1.99 |
| $CO_2$ Emissions (t/year) | 1.37 | DFEE | 40.63 | TFEE | 50.87 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 20.12 |
| % DPER < TPER | -5.45 | DPER | 90.87 | TPER | 86.17 |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Matthew Stainrod | Assessor ID | AU83-0001 |
| Client | | | |

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

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## 1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 90.4500 (1b) | x | 2.5000 (2b) | = | 226.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 90.4500 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 226.1250 | (5) |

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## 2. Ventilation rate

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| | | 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 | | 2 * 10 = | 20.0000 (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) = | | 20.0000 / (5) = | 0.0884 (8) |
| Pressure test | | | Yes |
| Pressure Test Method | | | Blower Door |
| Measured/design AP50 | | | 5.0000 (17) |
| Infiltration rate | | | 0.3384 (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) = | | 0.2877 (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 | 0.3668 | 0.3596 | 0.3524 | 0.3164 | 0.3093 | 0.2733 | 0.2733 | 0.2661 | 0.2877 | 0.3093 | 0.3236 | 0.3380 | (22b) |
| Effective ac | 0.5673 | 0.5647 | 0.5621 | 0.5501 | 0.5478 | 0.5373 | 0.5373 | 0.5354 | 0.5414 | 0.5478 | 0.5524 | 0.5571 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 22.5500 | 1.1450 | 25.8206 | | | (27) |
| External Wall | 92.0500 | 22.5500 | 69.5000 | 0.1500 | 10.4250 | 9.0000 | 625.5000 | (29a) |
| Communal Wall | 39.6500 | 2.1000 | 37.5500 | 0.1500 | 5.6325 | 9.0000 | 337.9500 | (29a) |
| External Roof | 90.4500 | | 90.4500 | 0.1000 | 9.0450 | 9.0000 | 814.0500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 222.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 53.0231 | | | (33) |
| Party Wall | | | 18.8500 | 0.0000 | 0.0000 | 20.0000 | 377.0000 | (32) |
| Party Floor | | | 90.4500 | | | 40.0000 | 3618.0000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6672.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 73.7700 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 11.1075 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 64.1306 (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 42.3302 | 42.1353 | 41.9443 | 41.0469 | 40.8790 | 40.0974 | 40.0974 | 39.9526 | 40.3984 | 40.8790 | 41.2186 | 41.5737 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 106.4609 | 106.2659 | 106.0749 | 105.1775 | 105.0096 | 104.2280 | 104.2280 | 104.0832 | 104.5290 | 105.0096 | 105.3492 | 105.7043 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 105.1767 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1770 | 1.1749 | 1.1727 | 1.1628 | 1.1610 | 1.1523 | 1.1523 | 1.1507 | 1.1557 | 1.1610 | 1.1647 | 1.1686 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1628 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6318 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 93.9770 | 92.5647 | 90.5067 | 86.5691 | 83.6633 | 80.4227 | 78.5808 | 80.6232 | 82.8621 | 86.3414 | 90.3636 | 93.6169 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29.5146 | 29.0763 | 28.4590 | 27.3209 | 26.4687 | 25.5237 | 25.0133 | 25.6262 | 26.2936 | 27.3048 | 28.4663 | 29.4148 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 41.5826 | 40.0705 | 38.5584 | 37.0463 | 35.5342 | 34.0221 | 34.0221 | 35.5342 | 37.0463 | 38.5584 | 40.0705 | 41.5826 (42c) |

Average daily hot water use (litres/day) 151.8107 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 165.0742 | 161.7115 | 157.5241 | 150.9363 | 145.6662 | 139.9685 | 137.6162 | 141.7836 | 146.2020 | 152.2046 | 158.9004 | 164.6143 | (44) |
| Energy conte | 261.4371 | 230.2750 | 242.1087 | 206.6243 | 196.0946 | 172.1076 | 166.4348 | 175.5577 | 180.2816 | 206.5402 | 226.3828 | 257.7463 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2521.5907 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 39.2156 | 34.5412 | 36.3163 | 30.9936 | 29.4142 | 25.8161 | 24.9652 | 26.3337 | 27.0422 | 30.9810 | 33.9574 | 38.6619 | (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 | | | | | | | | | | | | | |
| | 312.3960 | 276.3024 | 293.0676 | 255.9393 | 247.0536 | 221.4227 | 217.3937 | 226.5166 | 229.5967 | 257.4991 | 275.6978 | 308.7052 | (62) |
| WWHRS | -26.7321 | -23.6421 | -24.7567 | -20.4995 | -19.1048 | -16.3481 | -15.3237 | -16.2953 | -16.9144 | -19.9402 | -22.5898 | -26.2371 | (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 | | | | | | | | | | | | | |
| | 285.6639 | 252.6602 | 268.3109 | 235.4398 | 227.9488 | 205.0746 | 202.0700 | 210.2214 | 212.6823 | 237.5589 | 253.1080 | 282.4681 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2873.2070 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2873 | (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 | | | | | | | | | | | | | |
| | 99.6676 | 88.0733 | 93.2409 | 81.0313 | 77.9412 | 69.5546 | 68.0793 | 71.1127 | 72.2724 | 81.4143 | 87.6010 | 98.4404 | (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 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 121.0036 | 133.9683 | 121.0036 | 125.0371 | 121.0036 | 125.0371 | 121.0036 | 121.0036 | 125.0371 | 121.0036 | 125.0371 | 121.0036 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 239.9032 | 242.3926 | 236.1193 | 222.7642 | 205.9057 | 190.0611 | 179.4759 | 176.9865 | 183.2598 | 196.6149 | 213.4734 | 229.3180 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | (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) | | | | | | | | | | | | | |
| | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 133.9618 | 131.0614 | 125.3237 | 112.5435 | 104.7597 | 96.6036 | 91.5044 | 95.5815 | 100.3783 | 109.4279 | 121.6681 | 132.3123 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 560.3460 | 572.8998 | 547.9241 | 525.8222 | 497.1464 | 474.1791 | 454.4614 | 456.0491 | 471.1526 | 492.5239 | 525.6560 | 548.1114 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 4.1200 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 13.3888 | (74) |
| East | 5.1100 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 30.6719 | (76) |
| West | 13.3200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 79.9509 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 124.0115 | 241.9882 | 399.8605 | 589.5995 | 731.0652 | 752.7830 | 714.8257 | 607.8553 | 466.7623 | 287.2363 | 154.4504 | 102.1323 | (83) |
| Total gains | 684.3576 | 814.8880 | 947.7846 | 1115.4217 | 1228.2116 | 1226.9621 | 1169.2871 | 1063.9044 | 937.9149 | 779.7601 | 680.1064 | 650.2437 | (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 | 17.4099 | 17.4418 | 17.4732 | 17.6223 | 17.6505 | 17.7829 | 17.7829 | 17.8076 | 17.7316 | 17.6505 | 17.5936 | 17.5345 | |
| alpha | 2.1607 | 2.1628 | 2.1649 | 2.1748 | 2.1767 | 2.1855 | 2.1855 | 2.1872 | 2.1821 | 2.1767 | 2.1729 | 2.1690 | |
| util living area | | | | | | | | | | | | | |
| | 0.9178 | 0.8836 | 0.8284 | 0.7289 | 0.6039 | 0.4672 | 0.3597 | 0.4032 | 0.5922 | 0.7909 | 0.8891 | 0.9252 | (86) |
| MIT | 17.9560 | 18.3744 | 19.0031 | 19.7761 | 20.3742 | 20.7491 | 20.8985 | 20.8666 | 20.5572 | 19.7332 | 18.7126 | 17.8806 | (87) |
| Th 2 | 19.9384 | 19.9402 | 19.9419 | 19.9499 | 19.9514 | 19.9583 | 19.9583 | 19.9596 | 19.9556 | 19.9514 | 19.9483 | 19.9452 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9082 | 0.8704 | 0.8091 | 0.6990 | 0.5603 | 0.4068 | 0.2840 | 0.3248 | 0.5323 | 0.7599 | 0.8743 | 0.9164 | (89) |
| MIT 2 | 17.1762 | 17.5846 | 18.1941 | 18.9312 | 19.4763 | 19.7997 | 19.9103 | 19.8930 | 19.6544 | 18.9136 | 17.9290 | 17.1068 | (90) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4270 | (91) |
| MIT | 17.5091 | 17.9218 | 18.5395 | 19.2919 | 19.8597 | 20.2051 | 20.3322 | 20.3087 | 20.0399 | 19.2636 | 18.2636 | 17.4372 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.3591 | 17.7718 | 18.3895 | 19.1419 | 19.7097 | 20.0551 | 20.1822 | 20.1587 | 19.8899 | 19.1136 | 18.1136 | 17.2872 | (93) |

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8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8771 | 0.8363 | 0.7750 | 0.6730 | 0.5495 | 0.4127 | 0.3009 | 0.3405 | 0.5282 | 0.7306 | 0.8412 | 0.8866 | (94) |
| Useful gains | 600.2731 | 681.5019 | 734.5590 | 750.6867 | 674.8915 | 506.4050 | 351.8338 | 362.2901 | 495.4452 | 569.7260 | 572.1015 | 576.4828 | (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 | 1390.2874 | 1367.8353 | 1261.1796 | 1077.2210 | 841.0922 | 568.5715 | 373.3681 | 391.2186 | 605.2104 | 894.0044 | 1160.2711 | 1383.3746 | (97) |
| Space heating kWh | 587.7707 | 461.2160 | 391.8057 | 235.1047 | 123.6534 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 241.2632 | 423.4821 | 600.3275 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3064.6234 | |
| 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 | 587.7707 | 461.2160 | 391.8057 | 235.1047 | 123.6534 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 241.2632 | 423.4821 | 600.3275 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3064.6234 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.8820 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 %) | | | | | | | | | | | | 88.9000 | (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 | 587.7707 | 461.2160 | 391.8057 | 235.1047 | 123.6534 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 241.2632 | 423.4821 | 600.3275 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 661.1594 | 518.8032 | 440.7264 | 264.4597 | 139.0926 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 271.3872 | 476.3578 | 675.2841 | (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 | 285.6639 | 252.6602 | 268.3109 | 235.4398 | 227.9488 | 205.0746 | 202.0700 | 210.2214 | 212.6823 | 237.5589 | 253.1080 | 282.4681 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.8914 | 85.6533 | 85.1915 | 84.3784 | 83.1281 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.4146 | 85.4754 | 85.9545 | (217) |
| Fuel for water heating, kWh/month | 332.5872 | 294.9801 | 314.9503 | 279.0286 | 274.2138 | 255.3856 | 251.6438 | 261.7950 | 264.8597 | 281.4191 | 296.1178 | 328.6252 | (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 | 25.1422 | 20.1700 | 18.1608 | 13.3054 | 10.2775 | 8.3968 | 9.3755 | 12.1866 | 15.8292 | 20.7687 | 23.4582 | 25.8409 | (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) | | | | | | | | | | | | | |
| (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 | 3447.2704 | (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 | 3435.6061 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 202.9116 | (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 | 7171.7881 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3447.2704 | 0.2100 | 723.9268 | (261) |

| | | | | |
|---|---|---|---|---|
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3435.6061 | 0.2100 | 721.4773 | (264) |
| Space and water heating | | | 1445.4041 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 202.9116 | 0.1443 | 29.2864 | (268) |
| Total CO2, kg/year | | | 1486.6197 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 16.4400 | (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 | 3447.2704 | 1.1300 | 3895.4155 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3435.6061 | 1.1300 | 3882.2349 | (278) |
| Space and water heating | | | 7777.6504 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 202.9116 | 1.5338 | 311.2326 | (282) |
| Total Primary energy kWh/year | | | 8218.9838 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 90.8700 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 90.4500 | (1b) | x 2.5000 | (2b) = | 226.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 90.4500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 226.1250 | (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) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1327 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3827 | (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) = | 0.3253 | (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 | 0.4147 | 0.4066 | 0.3985 | 0.3578 | 0.3497 | 0.3090 | 0.3090 | 0.3009 | 0.3253 | 0.3497 | 0.3659 | 0.3822 | (22b) |
| Effective ac | 0.5860 | 0.5827 | 0.5794 | 0.5640 | 0.5611 | 0.5477 | 0.5477 | 0.5453 | 0.5529 | 0.5611 | 0.5670 | 0.5730 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 20.5200 | 1.1450 | 23.4962 | | | (27) |
| External Wall | 92.0500 | 20.5200 | 71.5300 | 0.1800 | 12.8754 | | | (29a) |
| Communal Wall | 39.6500 | 2.1000 | 37.5500 | 0.1800 | 6.7590 | | | (29a) |
| External Roof | 90.4500 | | 90.4500 | 0.1100 | 9.9495 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 222.1500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 55.1801 | | | (33) |
| Party Wall | | | 18.8500 | 0.0000 | 0.0000 | | | (32) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 73.7700 | (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 13.8000 | 0.0500 | 0.6900 |
| E3 | Sill | 9.6000 | 0.0500 | 0.4800 |
| E4 | Jamb | 44.8000 | 0.0500 | 2.2400 |
| E7 | Party floor between dwellings (in blocks of flats) | 46.0400 | 0.0700 | 3.2228 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 6.6400 | 0.0200 | 0.1328 |
| E14 | Flat roof | 15.8600 | 0.0800 | 1.2688 |
| E15 | Flat roof with parapet | 36.8200 | 0.5600 | 20.6192 |
| E16 | Corner (normal) | 20.0000 | 0.0900 | 1.8000 |

| | | | | |
|---|---|---|---|---|
| E17 Corner (inverted - internal area greater than external area) | 10.0000 | -0.0900 | -0.9000 | |
| E18 Party wall between dwellings | 2.5000 | 0.0600 | 0.1500 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 7.5400 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 7.5400 | 0.1200 | 0.9048 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.6084 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 85.7885 (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 | 43.7277 | 43.4786 | 43.2343 | 42.0871 | 41.8724 | 40.8732 | 40.8732 | 40.6882 | 41.2581 | 41.8724 | 42.3066 | 42.7606 | (38) |
| Heat transfer coeff | 129.5162 | 129.2670 | 129.0228 | 127.8756 | 127.6609 | 126.6617 | 126.6617 | 126.4767 | 127.0466 | 127.6609 | 128.0951 | 128.5491 | (39) |

Average = Sum(39)m / 12 = 127.8745

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.4319 | 1.4292 | 1.4265 | 1.4138 | 1.4114 | 1.4004 | 1.4004 | 1.3983 | 1.4046 | 1.4114 | 1.4162 | 1.4212 | (40) |
| HLP (average) | | | | | | | | | | | | 1.4138 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6318 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 68.3469 | 67.3198 | 65.8231 | 62.9594 | 60.8460 | 58.4892 | 57.1497 | 58.6350 | 60.2633 | 62.7938 | 65.7190 | 68.0850 | (42a) |
| Hot water usage for baths | 29.5146 | 29.0763 | 28.4590 | 27.3209 | 26.4687 | 25.5237 | 25.0133 | 25.6262 | 26.2936 | 27.3048 | 28.4663 | 29.4148 | (42b) |
| Hot water usage for other uses | 41.5826 | 40.0705 | 38.5584 | 37.0463 | 35.5342 | 34.0221 | 34.0221 | 35.5342 | 37.0463 | 38.5584 | 40.0705 | 41.5826 | (42c) |

Average daily hot water use (litres/day) 128.1806 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.4441 | 136.4665 | 132.8405 | 127.3265 | 122.8489 | 118.0351 | 116.1850 | 119.7955 | 123.6032 | 128.6569 | 134.2558 | 139.0824 | (44) |
| Energy conte | 220.8453 | 194.3265 | 204.1708 | 174.3037 | 165.3782 | 145.1379 | 140.5157 | 148.3318 | 152.4151 | 174.5862 | 191.2720 | 217.7695 | (45) |

Energy content (annual) Total = Sum(45)m = 2129.0529

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 33.1268 | 29.1490 | 30.6256 | 26.1456 | 24.8067 | 21.7707 | 21.0774 | 22.2498 | 22.8623 | 26.1879 | 28.6908 | 32.6654 | (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 | 271.8043 | 240.3539 | 255.1297 | 223.6187 | 216.3371 | 194.4529 | 191.4746 | 199.2907 | 201.7302 | 225.5451 | 240.5871 | 268.7284 | (62) |
| WWHRS | -31.2453 | -27.6336 | -28.9364 | -23.9604 | -22.3303 | -19.1082 | -17.9109 | -19.0464 | -19.7701 | -23.3067 | -26.4037 | -30.6667 | (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 | 240.5589 | 212.7203 | 226.1934 | 199.6583 | 194.0069 | 175.3448 | 173.5638 | 180.2443 | 181.9601 | 202.2384 | 214.1834 | 238.0617 | (64) |

Total per year (kWh/year) = Sum(64)m = 2438.7342 (64)

12Total per year (kWh/year) 2439 (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 | 86.1708 | 76.1204 | 80.6265 | 70.2847 | 67.7280 | 60.5871 | 59.4612 | 62.0601 | 63.0068 | 70.7896 | 75.9267 | 85.1481 | (65) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | 131.5915 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 120.9794 | 133.9414 | 120.9794 | 125.0120 | 120.9794 | 125.0120 | 120.9794 | 120.9794 | 125.0120 | 120.9794 | 125.0120 | 120.9794 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 239.9032 | 242.3926 | 236.1193 | 222.7642 | 205.9057 | 190.0611 | 179.4759 | 176.9865 | 183.2598 | 196.6149 | 213.4734 | 229.3180 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | 36.1591 | (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) | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | -105.2732 | (71) |
| Water heating gains (Table 5) | 115.8210 | 113.2744 | 108.3690 | 97.6177 | 91.0322 | 84.1488 | 79.9210 | 83.4141 | 87.5094 | 95.1474 | 105.4538 | 114.4463 | (72) |
| Total internal gains | 542.1810 | 555.0860 | 530.9451 | 510.8713 | 483.3947 | 461.6993 | 442.8537 | 443.8573 | 458.2587 | 478.2191 | 509.4166 | 530.2212 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 3.7500 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 12.1864 | (74) |
| East | 4.6500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 27.9108 | (76) |
| West | 12.1200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 72.7481 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 112.8453 | 220.1990 | 363.8564 | 536.5124 | 665.2427 | 685.0061 | 650.4658 | 553.1252 | 424.7346 | 261.3728 | 140.5433 | 92.9362 | (83) |
| Total gains | 655.0263 | 775.2849 | 894.8015 | 1047.3837 | 1148.6374 | 1146.7054 | 1093.3196 | 996.9825 | 882.9933 | 739.5919 | 649.9599 | 623.1573 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 14.3107 | 14.3383 | 14.3655 | 14.4943 | 14.5187 | 14.6332 | 14.6332 | 14.6547 | 14.5889 | 14.5187 | 14.4695 | 14.4184 | |
| alpha | 1.9540 | 1.9559 | 1.9577 | 1.9663 | 1.9679 | 1.9755 | 1.9755 | 1.9770 | 1.9726 | 1.9679 | 1.9646 | 1.9612 | |
| util living area | 0.9304 | 0.9039 | 0.8612 | 0.7812 | 0.6740 | 0.5447 | 0.4335 | 0.4787 | 0.6612 | 0.8300 | 0.9077 | 0.9362 | (86) |
| MIT | 17.2796 | 17.6904 | 18.3595 | 19.2417 | 20.0027 | 20.5490 | 20.7978 | 20.7463 | 20.2913 | 19.2768 | 18.1312 | 17.2094 | (87) |
| Th 2 | 19.7390 | 19.7411 | 19.7431 | 19.7528 | 19.7546 | 19.7631 | 19.7631 | 19.7646 | 19.7598 | 19.7546 | 19.7509 | 19.7471 | (88) |
| util rest of house | 0.9211 | 0.8912 | 0.8425 | 0.7508 | 0.6258 | 0.4708 | 0.3328 | 0.3775 | 0.5937 | 0.7991 | 0.8934 | 0.9277 | (89) |
| MIT 2 | 15.5066 | 16.0158 | 16.8420 | 17.9154 | 18.8082 | 19.4124 | 19.6500 | 19.6132 | 19.1621 | 17.9879 | 16.5773 | 15.4213 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4270 | (91) |
| MIT | 16.2636 | 16.7308 | 17.4900 | 18.4817 | 19.3182 | 19.8977 | 20.1401 | 20.0970 | 19.6443 | 18.5382 | 17.2408 | 16.1848 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.2636 | 16.7308 | 17.4900 | 18.4817 | 19.3182 | 19.8977 | 20.1401 | 20.0970 | 19.6443 | 18.5382 | 17.2408 | 16.1848 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8835 | 0.8492 | 0.7986 | 0.7134 | 0.6067 | 0.4795 | 0.3654 | 0.4067 | 0.5865 | 0.7606 | 0.8529 | 0.8917 | (94) |
| Useful gains | 578.7293 | 658.3630 | 714.5627 | 747.1555 | 696.8442 | 549.8421 | 399.4766 | 405.4935 | 517.8908 | 562.5651 | 554.3697 | 555.6477 | (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 | 1549.4829 | 1529.3327 | 1417.9542 | 1225.2632 | 972.5484 | 671.0153 | 448.3940 | 467.5859 | 704.3796 | 1013.4039 | 1298.9881 | 1540.6368 | (97) |
| Space heating kWh | 722.2406 | 585.2916 | 523.3233 | 344.2375 | 205.1239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 335.4241 | 536.1252 | 732.8319 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3984.5983 | |
| 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 | 722.2406 | 585.2916 | 523.3233 | 344.2375 | 205.1239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 335.4241 | 536.1252 | 732.8319 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3984.5983 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 44.0530 | (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 | 722.2406 | 585.2916 | 523.3233 | 344.2375 | 205.1239 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 335.4241 | 536.1252 | 732.8319 | (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) | 781.6457 | 633.4325 | 566.3672 | 372.5515 | 221.9956 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 363.0131 | 580.2221 | 793.1081 | (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 | 240.5589 | 212.7203 | 226.1934 | 199.6583 | 194.0069 | 175.3448 | 173.5638 | 180.2443 | 181.9601 | 202.2384 | 214.1834 | 238.0617 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.5831 | 86.4325 | 86.1166 | 85.5371 | 84.5011 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.4574 | 86.2627 | 86.6252 | (217) |
| Fuel for water heating, kWh/month | 277.8358 | 246.1115 | 262.6593 | 233.4171 | 229.5910 | 218.3621 | 216.1442 | 224.4637 | 226.6004 | 236.6541 | 248.2919 | 274.8181 | (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 | 25.1371 | 20.1659 | 18.1572 | 13.3027 | 10.2754 | 8.3951 | 9.3736 | 12.1841 | 15.8260 | 20.7645 | 23.4535 | 25.8358 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -16.9632 | -25.5837 | -39.3051 | -47.3277 | -53.8200 | -51.2511 | -50.6151 | -46.3808 | -39.4405 | -30.5816 | -19.2280 | -14.4770 | (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 | -5.1095 | -11.0643 | -22.5988 | -34.8617 | -47.0218 | -47.6006 | -47.0541 | -39.4228 | -28.3456 | -16.1310 | -6.9174 | -4.0182 | (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 | 4312.3358 | (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 | 2894.9491 | (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) | 202.8710 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -745.1196 | (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 | 6751.0362 | (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 | 4312.3358 | 0.2100 | 905.5905 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2894.9491 | 0.2100 | 607.9393 | (264) |
| Space and water heating | | | 1513.5298 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 202.8710 | 0.1443 | 29.2806 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -434.9738 | 0.1332 | -57.9412 | |
| PV Unit electricity exported | -310.1459 | 0.1251 | -38.8038 | |
| Total | | | -96.7451 | (269) |
| Total CO2, kg/year | | | 1457.9946 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.1200 | (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 | 4312.3358 | 1.1300 | 4872.9395 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2894.9491 | 1.1300 | 3271.2925 | (278) |
| Space and water heating | | | 8144.2319 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 202.8710 | 1.5338 | 311.1703 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -434.9738 | 1.4922 | -649.0805 | |
| PV Unit electricity exported | -310.1459 | 0.4592 | -142.4247 | |
| Total | | | -791.5052 | (283) |
| Total Primary energy kWh/year | | | 7793.9978 | (286) |
| Target Primary Energy Rate (TPER) | | | 86.1700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F2 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F2 | **Prop Type Ref** | F2 |
| **Property** | F2 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 15.75 | **TER** | 15.57 |
| **Environmental** | 87 B | **% DER < TER** | | | -1.16 |
| **$CO_2$ Emissions (t/year)** | 1.16 | **DFEE** | 34.63 | **TFEE** | 45.08 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 23.19 |
| **% DPER < TPER** | -4.90 | **DPER** | 87.38 | **TPER** | 83.30 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 79.5600 | (1b) | x 2.5000 | (2b) = | 198.9000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.5600 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 198.9000 | (5) |

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## 2. Ventilation rate

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| | | 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 | 2 * 10 = | 20.0000 | (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) = | 20.0000 / (5) = | 0.1006 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3506 | (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) = | 0.2980 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.3799 | 0.3725 | 0.3650 | 0.3278 | 0.3203 | 0.2831 | 0.2831 | 0.2756 | 0.2980 | 0.3203 | 0.3352 | 0.3501 | (22b) |
| Effective ac | 0.5722 | 0.5694 | 0.5666 | 0.5537 | 0.5513 | 0.5401 | 0.5401 | 0.5380 | 0.5444 | 0.5513 | 0.5562 | 0.5613 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 20.7500 | 1.1450 | 23.7595 | | | (27) |
| External Wall | 88.1900 | 22.8500 | 65.3400 | 0.1500 | 9.8010 | 9.0000 | 588.0600 | (29a) |
| External Roof | 79.5600 | | 79.5600 | 0.1000 | 7.9560 | 9.0000 | 716.0400 | (30) |
| Total net area of external elements Aum(A, m2) | | | 167.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 43.6165 | | | (33) |
| Party Wall | | | 30.1000 | 0.0000 | 0.0000 | 20.0000 | 602.0000 | (32) |
| Party Floor | | | 79.5600 | | | 40.0000 | 3182.4000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 5988.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 75.2702 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 8.3875 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 52.0040 (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 37.5553 | 37.3714 | 37.1911 | 36.3442 | 36.1858 | 35.4482 | 35.4482 | 35.3116 | 35.7323 | 36.1858 | 36.5063 | 36.8414 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 89.5593 | 89.3754 | 89.1951 | 88.3483 | 88.1898 | 87.4523 | 87.4523 | 87.3157 | 87.7364 | 88.1898 | 88.5104 | 88.8454 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 88.3475 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1257 | 1.1234 | 1.1211 | 1.1105 | 1.1085 | 1.0992 | 1.0992 | 1.0975 | 1.1028 | 1.1085 | 1.1125 | 1.1167 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1105 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.4545 (42) |
| Hot water usage for mixer showers | | | | | | | | | | | | |
| | 89.8878 | 88.5369 | 86.5685 | 82.8022 | 80.0228 | 76.9233 | 75.1615 | 77.1150 | 79.2565 | 82.5845 | 86.4316 | 89.5434 (42a) |
| Hot water usage for baths | | | | | | | | | | | | |
| | 28.2357 | 27.8164 | 27.2259 | 26.1371 | 25.3218 | 24.4177 | 23.9294 | 24.5158 | 25.1543 | 26.1216 | 27.2329 | 28.1403 (42b) |
| Hot water usage for other uses | | | | | | | | | | | | |
| | 39.7661 | 38.3201 | 36.8740 | 35.4280 | 33.9820 | 32.5359 | 32.5359 | 33.9820 | 35.4280 | 36.8740 | 38.3201 | 39.7661 (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 145.2035 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 157.8896 | 154.6734 | 150.6684 | 144.3673 | 139.3266 | 133.8769 | 131.6268 | 135.6128 | 139.8388 | 145.5801 | 151.9845 | 157.4498 | (44) |
| Energy conte | 250.0585 | 220.2528 | 231.5717 | 197.6316 | 187.5603 | 164.6173 | 159.1913 | 167.9170 | 172.4352 | 197.5509 | 216.5299 | 246.5283 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2411.8448 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 37.5088 | 33.0379 | 34.7358 | 29.6447 | 28.1341 | 24.6926 | 23.8787 | 25.1875 | 25.8653 | 29.6326 | 32.4795 | 36.9792 | (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 | | | | | | | | | | | | | |
| | 301.0174 | 266.2802 | 282.5306 | 246.9467 | 238.5192 | 213.9324 | 210.1502 | 218.8759 | 221.7503 | 248.5098 | 265.8449 | 297.4872 | (62) |
| WWHRS | -25.5689 | -22.6134 | -23.6794 | -19.6075 | -18.2735 | -15.6368 | -14.6570 | -15.5862 | -16.1784 | -19.0725 | -21.6069 | -25.0954 | (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 | | | | | | | | | | | | | |
| | 275.4485 | 243.6669 | 258.8512 | 227.3392 | 220.2458 | 198.2956 | 195.4932 | 203.2897 | 205.5719 | 229.4372 | 244.2381 | 272.3917 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2774.2689 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2774 | (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 | | | | | | | | | | | | | |
| | 95.8842 | 84.7409 | 89.7373 | 78.0413 | 75.1035 | 67.0640 | 65.6708 | 68.5721 | 69.6635 | 78.4254 | 84.3249 | 94.7104 | (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 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 110.2175 | 122.0265 | 110.2175 | 113.8914 | 110.2175 | 113.8914 | 110.2175 | 110.2175 | 113.8914 | 110.2175 | 113.8914 | 110.2175 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 218.5185 | 220.7860 | 215.0719 | 202.9072 | 187.5515 | 173.1192 | 163.4776 | 161.2101 | 166.9242 | 179.0889 | 194.4446 | 208.8769 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | (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) | | | | | | | | | | | | | |
| | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 128.8766 | 126.1026 | 120.6147 | 108.3907 | 100.9456 | 93.1445 | 88.2672 | 92.1668 | 96.7548 | 105.4105 | 117.1180 | 127.2989 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 520.4295 | 531.7320 | 508.7210 | 488.0062 | 461.5315 | 439.9720 | 421.7792 | 423.4113 | 437.3873 | 457.5337 | 488.2709 | 509.2101 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 7.5100 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 45.0774 | (76) |
| South | 13.2400 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 189.1736 | (78) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 234.2511 | 397.9987 | 539.8743 | 657.8402 | 724.3698 | 713.0224 | 690.0181 | 641.7320 | 581.1601 | 438.8016 | 280.4415 | 200.5329 (83) |
| Total gains | 754.6805 | 929.7306 | 1048.5953 | 1145.8464 | 1185.9013 | 1152.9944 | 1111.7974 | 1065.1433 | 1018.5474 | 896.3354 | 768.7124 | 709.7431 (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| tau | 18.5740 | 18.6122 | 18.6498 | 18.8286 | 18.8624 | 19.0215 | 19.0215 | 19.0512 | 18.9599 | 18.8624 | 18.7941 | 18.7232 |
| alpha | 2.2383 | 2.2408 | 2.2433 | 2.2552 | 2.2575 | 2.2681 | 2.2681 | 2.2701 | 2.2640 | 2.2575 | 2.2529 | 2.2482 |
| util living area | | | | | | | | | | | | |
| | 0.8797 | 0.8244 | 0.7605 | 0.6684 | 0.5589 | 0.4319 | 0.3250 | 0.3503 | 0.5035 | 0.7009 | 0.8340 | 0.8917 (86) |
| MIT | 18.4705 | 18.9529 | 19.4892 | 20.0724 | 20.5180 | 20.8102 | 20.9280 | 20.9123 | 20.7158 | 20.1152 | 19.1984 | 18.3758 (87) |
| Th 2 | 19.9799 | 19.9818 | 19.9836 | 19.9923 | 19.9939 | 20.0015 | 20.0015 | 20.0029 | 19.9986 | 19.9939 | 19.9906 | 19.9872 (88) |
| util rest of house | | | | | | | | | | | | |
| | 0.8670 | 0.8072 | 0.7376 | 0.6371 | 0.5166 | 0.3759 | 0.2576 | 0.2820 | 0.4475 | 0.6653 | 0.8147 | 0.8801 (89) |
| MIT 2 | 17.6991 | 18.1630 | 18.6758 | 19.2274 | 19.6302 | 19.8817 | 19.9674 | 19.9593 | 19.8090 | 19.2830 | 18.4169 | 17.6124 (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4183 (91) |
| MIT | 18.0218 | 18.4934 | 19.0160 | 19.5809 | 20.0016 | 20.2701 | 20.3692 | 20.3579 | 20.1884 | 19.6311 | 18.7438 | 17.9318 (92) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.8718 | 18.3434 | 18.8660 | 19.4309 | 19.8516 | 20.1201 | 20.2192 | 20.2079 | 20.0384 | 19.4811 | 18.5938 | 17.7818 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8341 | 0.7744 | 0.7090 | 0.6181 | 0.5103 | 0.3828 | 0.2727 | 0.2965 | 0.4498 | 0.6451 | 0.7827 | 0.8480 | (94) |
| Useful gains | 629.4723 | 719.9885 | 743.4248 | 708.2758 | 605.1656 | 441.3896 | 303.1869 | 315.8490 | 458.1731 | 578.2413 | 601.6452 | 601.8629 | (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 | 1215.4783 | 1201.5093 | 1102.9883 | 930.3866 | 718.8851 | 482.7460 | 316.5077 | 332.4910 | 521.0100 | 783.2227 | 1017.3205 | 1206.6769 | (97) |
| Space heating kWh | 435.9885 | 323.5820 | 267.5152 | 159.9197 | 84.6073 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.5061 | 299.2862 | 449.9816 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2173.3867 | |
| 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 | 435.9885 | 323.5820 | 267.5152 | 159.9197 | 84.6073 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.5061 | 299.2862 | 449.9816 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2173.3867 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 27.3176 | (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 %) | | | | | | | | | | | | 88.9000 | (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 | 435.9885 | 323.5820 | 267.5152 | 159.9197 | 84.6073 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.5061 | 299.2862 | 449.9816 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 490.4257 | 363.9843 | 300.9170 | 179.8872 | 95.1714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 171.5480 | 336.6549 | 506.1660 | (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 | 275.4485 | 243.6669 | 258.8512 | 227.3392 | 220.2458 | 198.2956 | 195.4932 | 203.2897 | 205.5719 | 229.4372 | 244.2381 | 272.3917 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.3605 | 84.9900 | 84.4521 | 83.6413 | 82.5154 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.5263 | 84.8181 | 85.4492 | (217) |
| Fuel for water heating, kWh/month | 322.6886 | 286.7005 | 306.5065 | 271.8025 | 266.9148 | 246.9435 | 243.4536 | 253.1627 | 256.0048 | 274.6885 | 287.9552 | 318.7763 | (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 | 23.4300 | 18.7964 | 16.9241 | 12.3993 | 9.5776 | 7.8250 | 8.7370 | 11.3567 | 14.7512 | 19.3543 | 21.8607 | 24.0812 | (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) | | | | | | | | | | | | | |
| (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 | 2444.7545 | (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 | 3335.5976 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 189.0932 | (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 | 6055.4453 | (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 | 2444.7545 | 0.2100 | 513.3984 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3335.5976 | 0.2100 | 700.4755 | (264) |

| | | | |
|---|---|---|---|
| Space and water heating | | | 1213.8739 (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 (267) |
| Energy for lighting | 189.0932 | 0.1443 | 27.2920 (268) |
| Total CO2, kg/year | | | 1253.0952 (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.7500 (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 | 2444.7545 | 1.1300 | 2762.5726 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3335.5976 | 1.1300 | 3769.2252 | (278) |
| Space and water heating | | | 6531.7978 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 189.0932 | 1.5338 | 290.0375 | (282) |
| Total Primary energy kWh/year | | | 6951.9361 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 87.3800 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 79.5600 (1b) | x | 2.5000 (2b) | = | 198.9000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.5600 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 198.9000 | (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) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1508 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4008 | (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) = | 0.3407 | (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 | 0.4344 | 0.4259 | 0.4174 | 0.3748 | 0.3663 | 0.3237 | 0.3237 | 0.3152 | 0.3407 | 0.3663 | 0.3833 | 0.4003 | (22b) |
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5702 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5580 | 0.5671 | 0.5735 | 0.5801 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 17.7900 | 1.1450 | 20.3702 | | | (27) |
| External Wall | 88.1900 | 19.8900 | 68.3000 | 0.1800 | 12.2940 | | | (29a) |
| External Roof | 79.5600 | | 79.5600 | 0.1100 | 8.7516 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 167.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 43.5158 | | | (33) |
| Party Wall | | | 30.1000 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 75.2702 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 12.3900 | 0.0500 | 0.6195 |
| E3 Sill | 7.0500 | 0.0500 | 0.3525 |
| E4 Jamb | 32.4000 | 0.0500 | 1.6200 |
| E7 Party floor between dwellings (in blocks of flats) | 29.8100 | 0.0700 | 2.0867 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.4600 | 0.0200 | 0.1092 |
| E15 Flat roof with parapet | 35.2700 | 0.5600 | 19.7512 |
| E16 Corner (normal) | 10.0000 | 0.0900 | 0.9000 |
| E17 Corner (inverted - internal area greater than external area) | 5.0000 | -0.0900 | -0.4500 |
| E18 Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 12.0400 | 0.0000 | 0.0000 |
| P4 Party wall - Roof (insulation at ceiling level) | 12.0400 | 0.1200 | 1.4448 |

E25 Staggered party wall between dwellings 2.5000 0.0600 0.1500
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.0339 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 70.5497 (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 | 39.0114 | 38.7710 | 38.5352 | 37.4281 | 37.2209 | 36.2566 | 36.2566 | 36.0781 | 36.6281 | 37.2209 | 37.6400 | 38.0781 | (38) |
| Heat transfer coeff | 109.5612 | 109.3207 | 109.0850 | 107.9778 | 107.7707 | 106.8064 | 106.8064 | 106.6278 | 107.1778 | 107.7707 | 108.1897 | 108.6278 | (39) |

Average = Sum(39)m / 12 = 107.9768

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3771 | 1.3741 | 1.3711 | 1.3572 | 1.3546 | 1.3425 | 1.3425 | 1.3402 | 1.3471 | 1.3546 | 1.3599 | 1.3654 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3572 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.4545 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.3729 | 64.3905 | 62.9589 | 60.2198 | 58.1984 | 55.9442 | 54.6629 | 56.0837 | 57.6411 | 60.0614 | 62.8594 | 65.1225 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.2357 | 27.8164 | 27.2259 | 26.1371 | 25.3218 | 24.4177 | 23.9294 | 24.5158 | 25.1543 | 26.1216 | 27.2329 | 28.1403 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.7661 | 38.3201 | 36.8740 | 35.4280 | 33.9820 | 32.5359 | 32.5359 | 33.9820 | 35.4280 | 36.8740 | 38.3201 | 39.7661 | (42c) |

Average daily hot water use (litres/day) 122.6016 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 133.3748 | 130.5270 | 127.0588 | 121.7849 | 117.5022 | 112.8979 | 111.1283 | 114.5814 | 118.2234 | 123.0571 | 128.4123 | 133.0288 | (44) |
| Energy conte | 211.2330 | 185.8686 | 195.2846 | 166.7174 | 158.1805 | 138.8211 | 134.4000 | 141.8758 | 145.7812 | 166.9873 | 182.9468 | 208.2910 | (45) |

Energy content (annual) Total = Sum(45)m = 2036.3874

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 31.6850 | 27.8803 | 29.2927 | 25.0076 | 23.7271 | 20.8232 | 20.1600 | 21.2814 | 21.8672 | 25.0481 | 27.4420 | 31.2437 | (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 | 262.1919 | 231.8960 | 246.2436 | 216.0325 | 209.1394 | 188.1362 | 185.3589 | 192.8347 | 195.0963 | 217.9462 | 232.2619 | 259.2499 | (62) |
| WWHRS | -29.8858 | -26.4312 | -27.6772 | -22.9179 | -21.3586 | -18.2767 | -17.1315 | -18.2176 | -18.9098 | -22.2926 | -25.2548 | -29.3323 | (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 | 232.3062 | 205.4648 | 218.5663 | 193.1146 | 187.7808 | 169.8594 | 168.2274 | 174.6170 | 176.1865 | 195.6536 | 207.0071 | 229.9176 | (64) |

Total per year (kWh/year) = Sum(64)m = 2358.7014 (64)

12Total per year (kWh/year) 2359 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 82.9747 | 73.3082 | 77.6719 | 67.7623 | 65.3347 | 58.4868 | 57.4277 | 59.9134 | 60.8010 | 68.2630 | 73.1586 | 81.9965 | (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 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 110.2116 | 122.0200 | 110.2116 | 113.8853 | 110.2116 | 113.8853 | 110.2116 | 110.2116 | 113.8853 | 110.2116 | 113.8853 | 110.2116 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 218.5185 | 220.7860 | 215.0719 | 202.9072 | 187.5515 | 173.1192 | 163.4776 | 161.2101 | 166.9242 | 179.0889 | 194.4446 | 208.8769 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | (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) | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | (71) |
| Water heating gains (Table 5) | 111.5251 | 109.0895 | 104.3977 | 94.1143 | 87.8155 | 81.2316 | 77.1878 | 80.5288 | 84.4459 | 91.7514 | 101.6092 | 110.2103 | (72) |
| Total internal gains | 503.0721 | 514.7124 | 492.4981 | 473.7237 | 448.3955 | 428.0531 | 410.6939 | 411.7674 | 425.0723 | 443.8687 | 472.7560 | 492.1157 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 6.4400 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 38.6549 | (76) |
| South | 11.3500 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 162.1692 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 200.8242 | 341.2087 | 462.8472 | 563.9918 | 621.0373 | 611.3114 | 591.5875 | 550.1845 | 498.2459 | 376.1915 | 240.4240 | 171.9171 | (83) |
| Total gains | 703.8963 | 855.9211 | 955.3453 | 1037.7155 | 1069.4328 | 1039.3645 | 1002.2814 | 961.9519 | 923.3182 | 820.0603 | 713.1800 | 664.0328 | (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 | 15.1830 | 15.2164 | 15.2493 | 15.4057 | 15.4353 | 15.5747 | 15.5747 | 15.6007 | 15.5207 | 15.4353 | 15.3755 | 15.3135 | |
| alpha | 2.0122 | 2.0144 | 2.0166 | 2.0270 | 2.0290 | 2.0383 | 2.0383 | 2.0400 | 2.0347 | 2.0290 | 2.0250 | 2.0209 | |
| util living area | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.9046 | 0.8643 | 0.8167 | 0.7431 | 0.6479 | 0.5246 | 0.4098 | 0.4373 | 0.5939 | 0.7673 | 0.8704 | 0.9135 | (86) |
| MIT | 17.7132 | 18.1857 | 18.7866 | 19.5135 | 20.1402 | 20.6138 | 20.8346 | 20.8048 | 20.4671 | 19.6339 | 18.5507 | 17.6279 | (87) |
| Th 2 | 19.7809 | 19.7833 | 19.7856 | 19.7963 | 19.7983 | 19.8077 | 19.8077 | 19.8095 | 19.8041 | 19.7983 | 19.7942 | 19.7900 | (88) |
| util rest of house | 0.8927 | 0.8482 | 0.7945 | 0.7107 | 0.5999 | 0.4534 | 0.3156 | 0.3439 | 0.5267 | 0.7309 | 0.8521 | 0.9026 | (89) |
| MIT 2 | 16.0435 | 16.6250 | 17.3631 | 18.2462 | 18.9813 | 19.5057 | 19.7143 | 19.6929 | 19.3607 | 18.4133 | 17.0943 | 15.9408 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4183 | (91) |
| MIT | 16.7419 | 17.2778 | 17.9586 | 18.7763 | 19.4661 | 19.9692 | 20.1829 | 20.1580 | 19.8235 | 18.9239 | 17.7035 | 16.6465 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.7419 | 17.2778 | 17.9586 | 18.7763 | 19.4661 | 19.9692 | 20.1829 | 20.1580 | 19.8235 | 18.9239 | 17.7035 | 16.6465 | (93) |

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8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8518 | 0.8049 | 0.7533 | 0.6787 | 0.5852 | 0.4637 | 0.3468 | 0.3728 | 0.5279 | 0.6994 | 0.8105 | 0.8631 | (94) |
| Useful gains | 599.6113 | 688.9241 | 719.6186 | 704.3377 | 625.8187 | 481.9488 | 347.5583 | 358.6029 | 487.3997 | 573.5670 | 578.0537 | 573.1165 | (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 | 1363.1537 | 1353.1510 | 1249.9563 | 1066.4259 | 836.9530 | 573.4668 | 382.6802 | 400.7117 | 613.4353 | 897.0730 | 1147.1894 | 1352.0375 | (97) |
| Space heating kWh | 568.0756 | 446.3604 | 394.5713 | 260.7035 | 157.0840 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 240.6884 | 409.7777 | 579.5173 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3056.7781 | |
| 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 | 568.0756 | 446.3604 | 394.5713 | 260.7035 | 157.0840 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 240.6884 | 409.7777 | 579.5173 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3056.7781 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 38.4210 | (99) |

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

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| | | |
|---|---|---|
| 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 | 568.0756 | 446.3604 | 394.5713 | 260.7035 | 157.0840 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 240.6884 | 409.7777 | 579.5173 | (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) | 614.8004 | 483.0741 | 427.0252 | 282.1466 | 170.0043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 260.4853 | 443.4824 | 627.1832 | (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 | 232.3062 | 205.4648 | 218.5663 | 193.1146 | 187.7808 | 169.8594 | 168.2274 | 174.6170 | 176.1865 | 195.6536 | 207.0071 | 229.9176 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.2199 | 85.9968 | 85.6308 | 85.0251 | 84.0014 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.8264 | 85.8154 | 86.2754 | (217) |
| Fuel for water heating, kWh/month | 269.4346 | 238.9214 | 255.2426 | 227.1266 | 223.5448 | 211.5311 | 209.4986 | 217.4558 | 219.4103 | 230.6517 | 241.2238 | 266.4926 | (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 | 22.8998 | 18.3711 | 16.5411 | 12.1187 | 9.3609 | 7.6479 | 8.5393 | 11.0997 | 14.4174 | 18.9164 | 21.3660 | 23.5362 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -15.0031 | -22.6728 | -34.9038 | -42.1194 | -47.9833 | -45.7303 | -45.1690 | -41.3519 | -35.1036 | -27.1456 | -17.0235 | -12.7996 | (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 | -4.4122 | -9.5628 | -19.5469 | -30.1745 | -40.7174 | -41.2199 | -40.7411 | -34.1211 | -24.5211 | -13.9429 | -5.9740 | -3.4689 | (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 | 3308.2014 | (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 | 2810.5339 | (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) | 184.8144 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -655.4087 | (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 | 5734.1410 | (238) |

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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 | 3308.2014 | 0.2100 | 694.7223 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2810.5339 | 0.2100 | 590.2121 | (264) |
| Space and water heating | | | 1284.9344 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 184.8144 | 0.1443 | 26.6744 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -387.0060 | 0.1332 | -51.5344 | |
| PV Unit electricity exported | -268.4027 | 0.1251 | -33.5768 | |
| Total | | | -85.1113 | (269) |
| Total CO2, kg/year | | | 1238.4268 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.5700 | (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 | 3308.2014 | 1.1300 | 3738.2676 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2810.5339 | 1.1300 | 3175.9033 | (278) |
| Space and water heating | | | 6914.1709 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 184.8144 | 1.5338 | 283.4746 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -387.0060 | 1.4921 | -577.4370 | |
| PV Unit electricity exported | -268.4027 | 0.4592 | -123.2396 | |
| Total | | | -700.6766 | (283) |
| Total Primary energy kWh/year | | | 6627.0696 | (286) |
| Target Primary Energy Rate (TPER) | | | 83.3000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Property Reference | F2 | Issued on Date | 02/10/2024 |
| Assessment Reference | F2 | Prop Type Ref | F2 |
| Property | F2 | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 84 B | DER | 15.75 | TER | 15.57 |
| Environmental | 87 B | % DER < TER | | | -1.16 |
| $CO_2$ Emissions (t/year) | 1.16 | DFEE | 34.63 | TFEE | 45.08 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 23.19 |
| % DPER < TPER | -4.90 | DPER | 87.38 | TPER | 83.30 |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Matthew Stainrod | Assessor ID | AU83-0001 |
| Client | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 79.5600 (1b) | x | 2.5000 (2b) | = | 198.9000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.5600 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 198.9000 | (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) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1508 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4008 | (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) = | 0.3407 | (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 | 0.4344 | 0.4259 | 0.4174 | 0.3748 | 0.3663 | 0.3237 | 0.3237 | 0.3152 | 0.3407 | 0.3663 | 0.3833 | 0.4003 | (22b) |

| | |
|---|---|
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 0.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5702 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5580 | 0.5671 | 0.5735 | 0.5801 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 20.7500 | 1.1450 | 23.7595 | | | (27) |
| External Wall | 88.1900 | 22.8500 | 65.3400 | 0.1500 | 9.8010 | 9.0000 | 588.0600 | (29a) |
| External Roof | 79.5600 | | 79.5600 | 0.1000 | 7.9560 | 9.0000 | 716.0400 | (30) |
| Total net area of external elements Aum(A, m2) | | | 167.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 43.6165 | | | (33) |
| Party Wall | | | 30.1000 | 0.0000 | 0.0000 | 20.0000 | 602.0000 | (32) |
| Party Floor | | | 79.5600 | | | 40.0000 | 3182.4000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | |
|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 5988.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 75.2702 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | 8.3875 (36) |
| Point Thermal bridges | (36a) = 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = 52.0040 (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 | 39.0114 | 38.7710 | 38.5352 | 37.4281 | 37.2209 | 36.2566 | 36.2566 | 36.0781 | 36.6281 | 37.2209 | 37.6400 | 38.0781 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 91.0155 | 90.7750 | 90.5393 | 89.4321 | 89.2250 | 88.2607 | 88.2607 | 88.0821 | 88.6321 | 89.2250 | 89.6440 | 90.0821 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 89.4311 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1440 | 1.1410 | 1.1380 | 1.1241 | 1.1215 | 1.1094 | 1.1094 | 1.1071 | 1.1140 | 1.1215 | 1.1267 | 1.1323 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1241 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.4545 | (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 | | | | | | | | | | | | | |
| | 28.2357 | 27.8164 | 27.2259 | 26.1371 | 25.3218 | 24.4177 | 23.9294 | 24.5158 | 25.1543 | 26.1216 | 27.2329 | 28.1403 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 39.7661 | 38.3201 | 36.8740 | 35.4280 | 33.9820 | 32.5359 | 32.5359 | 33.9820 | 35.4280 | 36.8740 | 38.3201 | 39.7661 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 62.3300 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 68.0018 | 66.1365 | 64.0999 | 61.5650 | 59.3037 | 56.9537 | 56.4653 | 58.4978 | 60.5823 | 62.9957 | 65.5529 | 67.9064 | (44) |
| Energy conte | 107.6983 | 94.1774 | 98.5192 | 84.2795 | 79.8342 | 70.0312 | 68.2899 | 72.4325 | 74.7040 | 85.4845 | 93.3922 | 106.3250 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1035.1678 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 91.5435 | 80.0508 | 83.7413 | 71.6376 | 67.8591 | 59.5265 | 58.0464 | 61.5676 | 63.4984 | 72.6618 | 79.3833 | 90.3762 | (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 | | | | | | | | | | | | | |
| | 91.5435 | 80.0508 | 83.7413 | 71.6376 | 67.8591 | 59.5265 | 58.0464 | 61.5676 | 63.4984 | 72.6618 | 79.3833 | 90.3762 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 879.8927 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 880 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 52.3528 | 46.6468 | 50.9365 | 48.6081 | 49.5202 | 47.2375 | 48.8120 | 49.5202 | 48.6081 | 50.9365 | 49.9787 | 52.3528 | (64a) |
| | | | | | | | | | | | | | |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 595.5102 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 35.9741 | 31.6744 | 33.6694 | 30.0614 | 29.3448 | 26.6910 | 26.7146 | 27.7719 | 28.0266 | 30.8996 | 32.3405 | 35.6823 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 110.2175 | 122.0265 | 110.2175 | 113.8914 | 110.2175 | 113.8914 | 110.2175 | 110.2175 | 113.8914 | 110.2175 | 113.8914 | 110.2175 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 218.5185 | 220.7860 | 215.0719 | 202.9072 | 187.5515 | 173.1192 | 163.4776 | 161.2101 | 166.9242 | 179.0889 | 194.4446 | 208.8769 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | (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) | | | | | | | | | | | | | |
| | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 48.3523 | 47.1345 | 45.2546 | 41.7520 | 39.4420 | 37.0708 | 35.9068 | 37.3279 | 38.9259 | 41.5317 | 44.9174 | 47.9600 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 436.9051 | 449.7639 | 430.3609 | 418.3675 | 397.0278 | 383.8984 | 369.4188 | 368.5724 | 379.5584 | 390.6550 | 413.0703 | 426.8713 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 7.5100 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 45.0774 | (76) |
| South | 13.2400 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 189.1736 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 234.2511 | 397.9987 | 539.8743 | 657.8402 | 724.3698 | 713.0224 | 690.0181 | 641.7320 | 581.1601 | 438.8016 | 280.4415 | 200.5329 | (83) |
| Total gains | 671.1562 | 847.7626 | 970.2352 | 1076.2077 | 1121.3976 | 1096.9207 | 1059.4369 | 1010.3044 | 960.7184 | 829.4566 | 693.5118 | 627.4042 | (84) |

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## 7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 18.2768 | 18.3252 | 18.3729 | 18.6004 | 18.6436 | 18.8473 | 18.8473 | 18.8855 | 18.7683 | 18.6436 | 18.5564 | 18.4662 | |
| alpha | 2.2185 | 2.2217 | 2.2249 | 2.2400 | 2.2429 | 2.2565 | 2.2565 | 2.2590 | 2.2512 | 2.2429 | 2.2371 | 2.2311 | |
| util living area | | | | | | | | | | | | | |
| | 0.9019 | 0.8486 | 0.7862 | 0.6933 | 0.5829 | 0.4518 | 0.3415 | 0.3689 | 0.5278 | 0.7294 | 0.8594 | 0.9128 | (86) |
| MIT | 18.2391 | 18.7573 | 19.3358 | 19.9774 | 20.4634 | 20.7879 | 20.9187 | 20.9005 | 20.6808 | 20.0163 | 19.0239 | 18.1470 | (87) |
| Th 2 | 19.9651 | 19.9675 | 19.9699 | 19.9812 | 19.9833 | 19.9932 | 19.9932 | 19.9950 | 19.9894 | 19.9833 | 19.9790 | 19.9746 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8909 | 0.8328 | 0.7644 | 0.6624 | 0.5401 | 0.3940 | 0.2708 | 0.2974 | 0.4705 | 0.6949 | 0.8420 | 0.9030 | (89) |
| MIT 2 | 17.4662 | 17.9677 | 18.5239 | 19.1348 | 19.5769 | 19.8589 | 19.9546 | 19.9454 | 19.7755 | 19.1886 | 18.2445 | 17.3830 | (90) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Living area fraction | | | | | | | | | | | fLA = Living area / (4) = | 0.4183 | (91) |
| MIT | 17.7895 | 18.2980 | 18.8635 | 19.4873 | 19.9477 | 20.2475 | 20.3578 | 20.3450 | 20.1542 | 19.5348 | 18.5705 | 17.7026 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.7895 | 18.2980 | 18.8635 | 19.4873 | 19.9477 | 20.2475 | 20.3578 | 20.3450 | 20.1542 | 19.5348 | 18.5705 | 17.7026 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8614 | 0.8023 | 0.7376 | 0.6461 | 0.5385 | 0.4091 | 0.2971 | 0.3230 | 0.4803 | 0.6778 | 0.8128 | 0.8747 | (94) |
| Useful gains | 578.1564 | 680.1722 | 715.6633 | 695.2935 | 603.8694 | 448.7774 | 314.7059 | 326.3751 | 461.4412 | 562.2168 | 563.6897 | 548.7852 | (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 | 1227.7568 | 1216.2044 | 1119.3835 | 946.8411 | 735.8998 | 498.4557 | 331.6699 | 347.4796 | 536.5939 | 797.2102 | 1028.2618 | 1216.3398 | (97) |
| Space heating kWh | 483.3027 | 360.2137 | 300.3679 | 181.1143 | 98.2306 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 174.8351 | 334.4919 | 496.6606 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2429.2168 | |
| 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 | 483.3027 | 360.2137 | 300.3679 | 181.1143 | 98.2306 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 174.8351 | 334.4919 | 496.6606 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2429.2168 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 30.5331 | (99) |

---

8c. Space cooling requirement

---

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 829.6504 | 653.1290 | 669.4240 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.8168 | 0.8657 | 0.8500 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 677.6970 | 565.4033 | 569.0179 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1239.7745 | 1198.1086 | 1142.8314 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 404.6958 | 470.7327 | 426.9172 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | | fC = cooled area / (4) = | 1.0000 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 101.1740 | 117.6832 | 106.7293 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 325.5865 | (107) |
| Energy for space heating | | | | | | | | | | | | 30.5331 | (99) |
| Energy for space cooling | | | | | | | | | | | | 4.0923 | (108) |
| Total | | | | | | | | | | | | 34.6255 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 34.6 | (109) |

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

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 79.5600 (1b) | x | 2.5000 (2b) | = | 198.9000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.5600 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 198.9000 | (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) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1508 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4008 | (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) = | 0.3407 | (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 | 0.4344 | 0.4259 | 0.4174 | 0.3748 | 0.3663 | 0.3237 | 0.3237 | 0.3152 | 0.3407 | 0.3663 | 0.3833 | 0.4003 | (22b) |

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5702 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5580 | 0.5671 | 0.5735 | 0.5801 (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 17.7900 | 1.1450 | 20.3702 | | | (27) |
| External Wall | 88.1900 | 19.8900 | 68.3000 | 0.1800 | 12.2940 | | | (29a) |
| External Roof | 79.5600 | | 79.5600 | 0.1100 | 8.7516 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 167.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 43.5158 | | | (33) |
| Party Wall | | | 30.1000 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 75.2702 (35)
List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 12.3900 | 0.0500 | 0.6195 |
| E3 | Sill | 7.0500 | 0.0500 | 0.3525 |
| E4 | Jamb | 32.4000 | 0.0500 | 1.6200 |
| E7 | Party floor between dwellings (in blocks of flats) | 29.8100 | 0.0700 | 2.0867 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 5.4600 | 0.0200 | 0.1092 |
| E15 | Flat roof with parapet | 35.2700 | 0.5600 | 19.7512 |
| E16 | Corner (normal) | 10.0000 | 0.0900 | 0.9000 |
| E17 | Corner (inverted - internal area greater than external area) | 5.0000 | -0.0900 | -0.4500 |
| E18 | Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 |
| P3 | Party wall - Intermediate floor between dwellings (in blocks of flats) | 12.0400 | 0.0000 | 0.0000 |
| P4 | Party wall - Roof (insulation at ceiling level) | 12.0400 | 0.1200 | 1.4448 |
| E25 | Staggered party wall between dwellings | 2.5000 | 0.0600 | 0.1500 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.0339 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 70.5497 (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 | 39.0114 | 38.7710 | 38.5352 | 37.4281 | 37.2209 | 36.2566 | 36.2566 | 36.0781 | 36.6281 | 37.2209 | 37.6400 | 38.0781 | (38) |
| Heat transfer coeff | 109.5612 | 109.3207 | 109.0850 | 107.9778 | 107.7707 | 106.8064 | 106.8064 | 106.6278 | 107.1778 | 107.7707 | 108.1897 | 108.6278 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 107.9768 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3771 | 1.3741 | 1.3711 | 1.3572 | 1.3546 | 1.3425 | 1.3425 | 1.3402 | 1.3471 | 1.3546 | 1.3599 | 1.3654 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3572 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.4545 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.2357 | 27.8164 | 27.2259 | 26.1371 | 25.3218 | 24.4177 | 23.9294 | 24.5158 | 25.1543 | 26.1216 | 27.2329 | 28.1403 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.7661 | 38.3201 | 36.8740 | 35.4280 | 33.9820 | 32.5359 | 32.5359 | 33.9820 | 35.4280 | 36.8740 | 38.3201 | 39.7661 | (42c) |

Average daily hot water use (litres/day) 62.3300 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 68.0018 | 66.1365 | 64.0999 | 61.5650 | 59.3037 | 56.9537 | 56.4653 | 58.4978 | 60.5823 | 62.9957 | 65.5529 | 67.9064 | (44) |
| Energy conte | 107.6983 | 94.1774 | 98.5192 | 84.2795 | 79.8342 | 70.0312 | 68.2899 | 72.4325 | 74.7040 | 85.4845 | 93.3922 | 106.3250 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1035.1678 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 91.5435 | 80.0508 | 83.7413 | 71.6376 | 67.8591 | 59.5265 | 58.0464 | 61.5676 | 63.4984 | 72.6618 | 79.3833 | 90.3762 | (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 | | | | | | | | | | | | | |
| | 91.5435 | 80.0508 | 83.7413 | 71.6376 | 67.8591 | 59.5265 | 58.0464 | 61.5676 | 63.4984 | 72.6618 | 79.3833 | 90.3762 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 879.8927 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 880 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 52.3528 | 46.6468 | 50.9365 | 48.6081 | 49.5202 | 47.2375 | 48.8120 | 49.5202 | 48.6081 | 50.9365 | 49.9787 | 52.3528 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 595.5102 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 35.9741 | 31.6744 | 33.6694 | 30.0614 | 29.3448 | 26.6910 | 26.7146 | 27.7719 | 28.0266 | 30.8996 | 32.3405 | 35.6823 | (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 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 110.2116 | 122.0200 | 110.2116 | 113.8853 | 110.2116 | 113.8853 | 110.2116 | 110.2116 | 113.8853 | 110.2116 | 113.8853 | 110.2116 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 218.5185 | 220.7860 | 215.0719 | 202.9072 | 187.5515 | 173.1192 | 163.4776 | 161.2101 | 166.9242 | 179.0889 | 194.4446 | 208.8769 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | (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) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 48.3523 | 47.1345 | 45.2546 | 41.7520 | 39.4420 | 37.0708 | 35.9068 | 37.3279 | 38.9259 | 41.5317 | 44.9174 | 47.9600 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 436.8992 | 449.7574 | 430.3550 | 418.3614 | 397.0219 | 383.8923 | 369.4129 | 368.5665 | 379.5523 | 390.6491 | 413.0642 | 426.8654 | (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 6.4400 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 38.6549 | (76) |
| South | 11.3500 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 162.1692 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 200.8242 | 341.2087 | 462.8472 | 563.9918 | 621.0373 | 611.3114 | 591.5875 | 550.1845 | 498.2459 | 376.1915 | 240.4240 | 171.9171 | (83) |
| Total gains | 637.7234 | 790.9661 | 893.2023 | 982.3531 | 1018.0592 | 995.2037 | 961.0004 | 918.7510 | 877.7982 | 766.8406 | 653.4882 | 598.7825 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 15.1830 | 15.2164 | 15.2493 | 15.4057 | 15.4353 | 15.5747 | 15.5747 | 15.6007 | 15.5207 | 15.4353 | 15.3755 | 15.3135 | |
| alpha | 2.0122 | 2.0144 | 2.0166 | 2.0270 | 2.0290 | 2.0383 | 2.0383 | 2.0400 | 2.0347 | 2.0290 | 2.0250 | 2.0209 | |
| util living area | | | | | | | | | | | | | |
| | 0.9185 | 0.8792 | 0.8327 | 0.7593 | 0.6646 | 0.5399 | 0.4234 | 0.4526 | 0.6116 | 0.7860 | 0.8863 | 0.9268 | (86) |
| MIT | 17.5726 | 18.0633 | 18.6858 | 19.4434 | 20.0950 | 20.5916 | 20.8240 | 20.7915 | 20.4352 | 19.5602 | 18.4355 | 17.4851 | (87) |
| Th 2 | 19.7809 | 19.7833 | 19.7856 | 19.7963 | 19.7983 | 19.8077 | 19.8077 | 19.8095 | 19.8041 | 19.7983 | 19.7942 | 19.7900 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9080 | 0.8644 | 0.8117 | 0.7279 | 0.6171 | 0.4681 | 0.3272 | 0.3573 | 0.5445 | 0.7512 | 0.8697 | 0.9173 | (89) |
| MIT 2 | 16.7032 | 17.1811 | 17.7855 | 18.5149 | 19.1189 | 19.5554 | 19.7291 | 19.7110 | 19.4323 | 18.6442 | 17.5615 | 16.6232 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4183 | (91) |
| MIT | 17.0669 | 17.5502 | 18.1621 | 18.9033 | 19.5272 | 19.9888 | 20.1871 | 20.1629 | 19.8518 | 19.0274 | 17.9271 | 16.9837 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.0669 | 17.5502 | 18.1621 | 18.9033 | 19.5272 | 19.9888 | 20.1871 | 20.1629 | 19.8518 | 19.0274 | 17.9271 | 16.9837 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8764 | 0.8294 | 0.7774 | 0.7009 | 0.6052 | 0.4798 | 0.3595 | 0.3874 | 0.5474 | 0.7246 | 0.8364 | 0.8872 | (94) |
| Useful gains | 558.8880 | 656.0603 | 694.4016 | 688.4861 | 616.1692 | 477.4981 | 345.4707 | 355.8825 | 480.5485 | 555.6754 | 546.5787 | 531.2406 | (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 | | | | | | | | | | | | | |
| | 1398.7513 | 1382.9235 | 1272.1589 | 1080.1375 | 843.5412 | 575.5635 | 383.1232 | 401.2349 | 616.4695 | 908.2258 | 1171.3802 | 1388.6698 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 624.8584 | 488.4520 | 429.8515 | 281.9890 | 169.1648 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 262.2975 | 449.8571 | 637.9273 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3344.3976 | |
| 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 | | | | | | | | | | | | | |
| | 624.8584 | 488.4520 | 429.8515 | 281.9890 | 169.1648 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 262.2975 | 449.8571 | 637.9273 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3344.3976 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 42.0362 | (99) |

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1003.9798 | 790.3671 | 810.3712 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7070 | 0.7692 | 0.7491 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 709.8543 | 607.9390 | 607.0770 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1120.8910 | 1083.0592 | 1035.8271 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 295.9464 | 353.4894 | 318.9901 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 73.9866 | 88.3724 | 79.7475 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 242.1065 | (107) |
| Energy for space heating | | | | | | | | | | | | 42.0362 | (99) |
| Energy for space cooling | | | | | | | | | | | | 3.0431 | (108) |
| Total | | | | | | | | | | | | 45.0792 | (109) |
| Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 45.1 | (109) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F2 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F2 | **Prop Type Ref** | F2 |
| **Property** | F2 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 15.75 | **TER** | 15.57 |
| **Environmental** | 87 B | **% DER < TER** | | | -1.16 |
| **$CO_2$ Emissions (t/year)** | 1.16 | **DFEE** | 34.63 | **TFEE** | 45.08 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 23.19 |
| **% DPER < TPER** | -4.90 | **DPER** | 87.38 | **TPER** | 83.30 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 79.5600 | (1b) | x 2.5000 | (2b) = | 198.9000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.5600 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 198.9000 | (5) |

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## 2. Ventilation rate

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| | | 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 | 2 * 10 = | 20.0000 | (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) = | 20.0000 / (5) = | 0.1006 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3506 | (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) = | 0.2980 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.3799 | 0.3725 | 0.3650 | 0.3278 | 0.3203 | 0.2831 | 0.2831 | 0.2756 | 0.2980 | 0.3203 | 0.3352 | 0.3501 | (22b) |
| Effective ac | 0.5722 | 0.5694 | 0.5666 | 0.5537 | 0.5513 | 0.5401 | 0.5401 | 0.5380 | 0.5444 | 0.5513 | 0.5562 | 0.5613 | (25) |

---

## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 20.7500 | 1.1450 | 23.7595 | | | (27) |
| External Wall | 88.1900 | 22.8500 | 65.3400 | 0.1500 | 9.8010 | 9.0000 | 588.0600 | (29a) |
| External Roof | 79.5600 | | 79.5600 | 0.1000 | 7.9560 | 9.0000 | 716.0400 | (30) |
| Total net area of external elements Aum(A, m2) | | | 167.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 43.6165 | | | (33) |
| Party Wall | | | 30.1000 | 0.0000 | 0.0000 | 20.0000 | 602.0000 | (32) |
| Party Floor | | | 79.5600 | | | 40.0000 | 3182.4000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 5988.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 75.2702 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 8.3875 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 52.0040 (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 37.5553 | 37.3714 | 37.1911 | 36.3442 | 36.1858 | 35.4482 | 35.4482 | 35.3116 | 35.7323 | 36.1858 | 36.5063 | 36.8414 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 89.5593 | 89.3754 | 89.1951 | 88.3483 | 88.1898 | 87.4523 | 87.4523 | 87.3157 | 87.7364 | 88.1898 | 88.5104 | 88.8454 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 88.3475 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1257 | 1.1234 | 1.1211 | 1.1105 | 1.1085 | 1.0992 | 1.0992 | 1.0975 | 1.1028 | 1.1085 | 1.1125 | 1.1167 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1105 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.4545 (42) |
| Hot water usage for mixer showers | | | | | | | | | | | | |
| | 89.8878 | 88.5369 | 86.5685 | 82.8022 | 80.0228 | 76.9233 | 75.1615 | 77.1150 | 79.2565 | 82.5845 | 86.4316 | 89.5434 (42a) |
| Hot water usage for baths | | | | | | | | | | | | |
| | 28.2357 | 27.8164 | 27.2259 | 26.1371 | 25.3218 | 24.4177 | 23.9294 | 24.5158 | 25.1543 | 26.1216 | 27.2329 | 28.1403 (42b) |
| Hot water usage for other uses | | | | | | | | | | | | |
| | 39.7661 | 38.3201 | 36.8740 | 35.4280 | 33.9820 | 32.5359 | 32.5359 | 33.9820 | 35.4280 | 36.8740 | 38.3201 | 39.7661 (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 145.2035 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 157.8896 | 154.6734 | 150.6684 | 144.3673 | 139.3266 | 133.8769 | 131.6268 | 135.6128 | 139.8388 | 145.5801 | 151.9845 | 157.4498 | (44) |
| Energy conte | 250.0585 | 220.2528 | 231.5717 | 197.6316 | 187.5603 | 164.6173 | 159.1913 | 167.9170 | 172.4352 | 197.5509 | 216.5299 | 246.5283 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2411.8448 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 37.5088 | 33.0379 | 34.7358 | 29.6447 | 28.1341 | 24.6926 | 23.8787 | 25.1875 | 25.8653 | 29.6326 | 32.4795 | 36.9792 | (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 | | | | | | | | | | | | | |
| | 301.0174 | 266.2802 | 282.5306 | 246.9467 | 238.5192 | 213.9324 | 210.1502 | 218.8759 | 221.7503 | 248.5098 | 265.8449 | 297.4872 | (62) |
| WWHRS | -25.5689 | -22.6134 | -23.6794 | -19.6075 | -18.2735 | -15.6368 | -14.6570 | -15.5862 | -16.1784 | -19.0725 | -21.6069 | -25.0954 | (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 | | | | | | | | | | | | | |
| | 275.4485 | 243.6669 | 258.8512 | 227.3392 | 220.2458 | 198.2956 | 195.4932 | 203.2897 | 205.5719 | 229.4372 | 244.2381 | 272.3917 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 2774.2689 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2774 | (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 | | | | | | | | | | | | | |
| | 95.8842 | 84.7409 | 89.7373 | 78.0413 | 75.1035 | 67.0640 | 65.6708 | 68.5721 | 69.6635 | 78.4254 | 84.3249 | 94.7104 | (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 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 110.2175 | 122.0265 | 110.2175 | 113.8914 | 110.2175 | 113.8914 | 110.2175 | 110.2175 | 113.8914 | 110.2175 | 113.8914 | 110.2175 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 218.5185 | 220.7860 | 215.0719 | 202.9072 | 187.5515 | 173.1192 | 163.4776 | 161.2101 | 166.9242 | 179.0889 | 194.4446 | 208.8769 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | (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) | | | | | | | | | | | | | |
| | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 128.8766 | 126.1026 | 120.6147 | 108.3907 | 100.9456 | 93.1445 | 88.2672 | 92.1668 | 96.7548 | 105.4105 | 117.1180 | 127.2989 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 520.4295 | 531.7320 | 508.7210 | 488.0062 | 461.5315 | 439.9720 | 421.7792 | 423.4113 | 437.3873 | 457.5337 | 488.2709 | 509.2101 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 7.5100 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 45.0774 | (76) |
| South | 13.2400 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 189.1736 | (78) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 234.2511 | 397.9987 | 539.8743 | 657.8402 | 724.3698 | 713.0224 | 690.0181 | 641.7320 | 581.1601 | 438.8016 | 280.4415 | 200.5329 (83) |
| Total gains | 754.6805 | 929.7306 | 1048.5953 | 1145.8464 | 1185.9013 | 1152.9944 | 1111.7974 | 1065.1433 | 1018.5474 | 896.3354 | 768.7124 | 709.7431 (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| tau | 18.5740 | 18.6122 | 18.6498 | 18.8286 | 18.8624 | 19.0215 | 19.0215 | 19.0512 | 18.9599 | 18.8624 | 18.7941 | 18.7232 |
| alpha | 2.2383 | 2.2408 | 2.2433 | 2.2552 | 2.2575 | 2.2681 | 2.2681 | 2.2701 | 2.2640 | 2.2575 | 2.2529 | 2.2482 |
| util living area | | | | | | | | | | | | |
| | 0.8797 | 0.8244 | 0.7605 | 0.6684 | 0.5589 | 0.4319 | 0.3250 | 0.3503 | 0.5035 | 0.7009 | 0.8340 | 0.8917 (86) |
| MIT | 18.4705 | 18.9529 | 19.4892 | 20.0724 | 20.5180 | 20.8102 | 20.9280 | 20.9123 | 20.7158 | 20.1152 | 19.1984 | 18.3758 (87) |
| Th 2 | 19.9799 | 19.9818 | 19.9836 | 19.9923 | 19.9939 | 20.0015 | 20.0015 | 20.0029 | 19.9986 | 19.9939 | 19.9906 | 19.9872 (88) |
| util rest of house | | | | | | | | | | | | |
| | 0.8670 | 0.8072 | 0.7376 | 0.6371 | 0.5166 | 0.3759 | 0.2576 | 0.2820 | 0.4475 | 0.6653 | 0.8147 | 0.8801 (89) |
| MIT 2 | 17.6991 | 18.1630 | 18.6758 | 19.2274 | 19.6302 | 19.8817 | 19.9674 | 19.9593 | 19.8090 | 19.2830 | 18.4169 | 17.6124 (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4183 (91) |
| MIT | 18.0218 | 18.4934 | 19.0160 | 19.5809 | 20.0016 | 20.2701 | 20.3692 | 20.3579 | 20.1884 | 19.6311 | 18.7438 | 17.9318 (92) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.8718 | 18.3434 | 18.8660 | 19.4309 | 19.8516 | 20.1201 | 20.2192 | 20.2079 | 20.0384 | 19.4811 | 18.5938 | 17.7818 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8341 | 0.7744 | 0.7090 | 0.6181 | 0.5103 | 0.3828 | 0.2727 | 0.2965 | 0.4498 | 0.6451 | 0.7827 | 0.8480 | (94) |
| Useful gains | 629.4723 | 719.9885 | 743.4248 | 708.2758 | 605.1656 | 441.3896 | 303.1869 | 315.8490 | 458.1731 | 578.2413 | 601.6452 | 601.8629 | (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 | 1215.4783 | 1201.5093 | 1102.9883 | 930.3866 | 718.8851 | 482.7460 | 316.5077 | 332.4910 | 521.0100 | 783.2227 | 1017.3205 | 1206.6769 | (97) |
| Space heating kWh | 435.9885 | 323.5820 | 267.5152 | 159.9197 | 84.6073 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.5061 | 299.2862 | 449.9816 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2173.3867 | |
| 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 | 435.9885 | 323.5820 | 267.5152 | 159.9197 | 84.6073 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.5061 | 299.2862 | 449.9816 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2173.3867 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 27.3176 | (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 %) | | | | | | | | | | | | 88.9000 | (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 | 435.9885 | 323.5820 | 267.5152 | 159.9197 | 84.6073 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.5061 | 299.2862 | 449.9816 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 490.4257 | 363.9843 | 300.9170 | 179.8872 | 95.1714 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 171.5480 | 336.6549 | 506.1660 | (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 | 275.4485 | 243.6669 | 258.8512 | 227.3392 | 220.2458 | 198.2956 | 195.4932 | 203.2897 | 205.5719 | 229.4372 | 244.2381 | 272.3917 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.3605 | 84.9900 | 84.4521 | 83.6413 | 82.5154 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.5263 | 84.8181 | 85.4492 | (217) |
| Fuel for water heating, kWh/month | 322.6886 | 286.7005 | 306.5065 | 271.8025 | 266.9148 | 246.9435 | 243.4536 | 253.1627 | 256.0048 | 274.6885 | 287.9552 | 318.7763 | (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 | 23.4300 | 18.7964 | 16.9241 | 12.3993 | 9.5776 | 7.8250 | 8.7370 | 11.3567 | 14.7512 | 19.3543 | 21.8607 | 24.0812 | (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) | | | | | | | | | | | | | |
| (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 | 2444.7545 | (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 | 3335.5976 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 189.0932 | (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 | 6055.4453 | (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 | 2444.7545 | 0.2100 | 513.3984 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3335.5976 | 0.2100 | 700.4755 | (264) |

| | | | |
|---|---|---|---|
| Space and water heating | | | 1213.8739 (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 (267) |
| Energy for lighting | 189.0932 | 0.1443 | 27.2920 (268) |
| Total CO2, kg/year | | | 1253.0952 (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.7500 (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 | 2444.7545 | 1.1300 | 2762.5726 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3335.5976 | 1.1300 | 3769.2252 | (278) |
| Space and water heating | | | 6531.7978 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 189.0932 | 1.5338 | 290.0375 | (282) |
| Total Primary energy kWh/year | | | 6951.9361 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 87.3800 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 79.5600 (1b) | x | 2.5000 (2b) | = | 198.9000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 79.5600 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 198.9000 | (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) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1508 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4008 | (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) = | 0.3407 | (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 | 0.4344 | 0.4259 | 0.4174 | 0.3748 | 0.3663 | 0.3237 | 0.3237 | 0.3152 | 0.3407 | 0.3663 | 0.3833 | 0.4003 | (22b) |
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5702 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5580 | 0.5671 | 0.5735 | 0.5801 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 17.7900 | 1.1450 | 20.3702 | | | (27) |
| External Wall | 88.1900 | 19.8900 | 68.3000 | 0.1800 | 12.2940 | | | (29a) |
| External Roof | 79.5600 | | 79.5600 | 0.1100 | 8.7516 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 167.7500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 43.5158 | | | (33) |
| Party Wall | | | 30.1000 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 75.2702 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 12.3900 | 0.0500 | 0.6195 |
| E3 Sill | 7.0500 | 0.0500 | 0.3525 |
| E4 Jamb | 32.4000 | 0.0500 | 1.6200 |
| E7 Party floor between dwellings (in blocks of flats) | 29.8100 | 0.0700 | 2.0867 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.4600 | 0.0200 | 0.1092 |
| E15 Flat roof with parapet | 35.2700 | 0.5600 | 19.7512 |
| E16 Corner (normal) | 10.0000 | 0.0900 | 0.9000 |
| E17 Corner (inverted - internal area greater than external area) | 5.0000 | -0.0900 | -0.4500 |
| E18 Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 12.0400 | 0.0000 | 0.0000 |
| P4 Party wall - Roof (insulation at ceiling level) | 12.0400 | 0.1200 | 1.4448 |

E25 Staggered party wall between dwellings 2.5000 0.0600 0.1500
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 27.0339 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 70.5497 (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 | 39.0114 | 38.7710 | 38.5352 | 37.4281 | 37.2209 | 36.2566 | 36.2566 | 36.0781 | 36.6281 | 37.2209 | 37.6400 | 38.0781 | (38) |
| Heat transfer coeff | 109.5612 | 109.3207 | 109.0850 | 107.9778 | 107.7707 | 106.8064 | 106.8064 | 106.6278 | 107.1778 | 107.7707 | 108.1897 | 108.6278 | (39) |

Average = Sum(39)m / 12 = 107.9768

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3771 | 1.3741 | 1.3711 | 1.3572 | 1.3546 | 1.3425 | 1.3425 | 1.3402 | 1.3471 | 1.3546 | 1.3599 | 1.3654 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3572 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.4545 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.3729 | 64.3905 | 62.9589 | 60.2198 | 58.1984 | 55.9442 | 54.6629 | 56.0837 | 57.6411 | 60.0614 | 62.8594 | 65.1225 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.2357 | 27.8164 | 27.2259 | 26.1371 | 25.3218 | 24.4177 | 23.9294 | 24.5158 | 25.1543 | 26.1216 | 27.2329 | 28.1403 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.7661 | 38.3201 | 36.8740 | 35.4280 | 33.9820 | 32.5359 | 32.5359 | 33.9820 | 35.4280 | 36.8740 | 38.3201 | 39.7661 | (42c) |

Average daily hot water use (litres/day) 122.6016 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 133.3748 | 130.5270 | 127.0588 | 121.7849 | 117.5022 | 112.8979 | 111.1283 | 114.5814 | 118.2234 | 123.0571 | 128.4123 | 133.0288 | (44) |
| Energy conte | 211.2330 | 185.8686 | 195.2846 | 166.7174 | 158.1805 | 138.8211 | 134.4000 | 141.8758 | 145.7812 | 166.9873 | 182.9468 | 208.2910 | (45) |

Energy content (annual) Total = Sum(45)m = 2036.3874

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 31.6850 | 27.8803 | 29.2927 | 25.0076 | 23.7271 | 20.8232 | 20.1600 | 21.2814 | 21.8672 | 25.0481 | 27.4420 | 31.2437 | (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 | 262.1919 | 231.8960 | 246.2436 | 216.0325 | 209.1394 | 188.1362 | 185.3589 | 192.8347 | 195.0963 | 217.9462 | 232.2619 | 259.2499 | (62) |
| WWHRS | -29.8858 | -26.4312 | -27.6772 | -22.9179 | -21.3586 | -18.2767 | -17.1315 | -18.2176 | -18.9098 | -22.2926 | -25.2548 | -29.3323 | (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 | 232.3062 | 205.4648 | 218.5663 | 193.1146 | 187.7808 | 169.8594 | 168.2274 | 174.6170 | 176.1865 | 195.6536 | 207.0071 | 229.9176 | (64) |

Total per year (kWh/year) = Sum(64)m = 2358.7014 (64)

12Total per year (kWh/year) 2359 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 82.9747 | 73.3082 | 77.6719 | 67.7623 | 65.3347 | 58.4868 | 57.4277 | 59.9134 | 60.8010 | 68.2630 | 73.1586 | 81.9965 | (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 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | 122.7230 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 110.2116 | 122.0200 | 110.2116 | 113.8853 | 110.2116 | 113.8853 | 110.2116 | 110.2116 | 113.8853 | 110.2116 | 113.8853 | 110.2116 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 218.5185 | 220.7860 | 215.0719 | 202.9072 | 187.5515 | 173.1192 | 163.4776 | 161.2101 | 166.9242 | 179.0889 | 194.4446 | 208.8769 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | 35.2723 | (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) | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | -98.1784 | (71) |
| Water heating gains (Table 5) | 111.5251 | 109.0895 | 104.3977 | 94.1143 | 87.8155 | 81.2316 | 77.1878 | 80.5288 | 84.4459 | 91.7514 | 101.6092 | 110.2103 | (72) |
| Total internal gains | 503.0721 | 514.7124 | 492.4981 | 473.7237 | 448.3955 | 428.0531 | 410.6939 | 411.7674 | 425.0723 | 443.8687 | 472.7560 | 492.1157 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 6.4400 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 38.6549 | (76) |
| South | 11.3500 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 162.1692 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 200.8242 | 341.2087 | 462.8472 | 563.9918 | 621.0373 | 611.3114 | 591.5875 | 550.1845 | 498.2459 | 376.1915 | 240.4240 | 171.9171 | (83) |
| Total gains | 703.8963 | 855.9211 | 955.3453 | 1037.7155 | 1069.4328 | 1039.3645 | 1002.2814 | 961.9519 | 923.3182 | 820.0603 | 713.1800 | 664.0328 | (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 | 15.1830 | 15.2164 | 15.2493 | 15.4057 | 15.4353 | 15.5747 | 15.5747 | 15.6007 | 15.5207 | 15.4353 | 15.3755 | 15.3135 | |
| alpha | 2.0122 | 2.0144 | 2.0166 | 2.0270 | 2.0290 | 2.0383 | 2.0383 | 2.0400 | 2.0347 | 2.0290 | 2.0250 | 2.0209 | |
| util living area | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.9046 | 0.8643 | 0.8167 | 0.7431 | 0.6479 | 0.5246 | 0.4098 | 0.4373 | 0.5939 | 0.7673 | 0.8704 | 0.9135 | (86) |
| MIT | 17.7132 | 18.1857 | 18.7866 | 19.5135 | 20.1402 | 20.6138 | 20.8346 | 20.8048 | 20.4671 | 19.6339 | 18.5507 | 17.6279 | (87) |
| Th 2 | 19.7809 | 19.7833 | 19.7856 | 19.7963 | 19.7983 | 19.8077 | 19.8077 | 19.8095 | 19.8041 | 19.7983 | 19.7942 | 19.7900 | (88) |
| util rest of house | 0.8927 | 0.8482 | 0.7945 | 0.7107 | 0.5999 | 0.4534 | 0.3156 | 0.3439 | 0.5267 | 0.7309 | 0.8521 | 0.9026 | (89) |
| MIT 2 | 16.0435 | 16.6250 | 17.3631 | 18.2462 | 18.9813 | 19.5057 | 19.7143 | 19.6929 | 19.3607 | 18.4133 | 17.0943 | 15.9408 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4183 | (91) |
| MIT | 16.7419 | 17.2778 | 17.9586 | 18.7763 | 19.4661 | 19.9692 | 20.1829 | 20.1580 | 19.8235 | 18.9239 | 17.7035 | 16.6465 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.7419 | 17.2778 | 17.9586 | 18.7763 | 19.4661 | 19.9692 | 20.1829 | 20.1580 | 19.8235 | 18.9239 | 17.7035 | 16.6465 | (93) |

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8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8518 | 0.8049 | 0.7533 | 0.6787 | 0.5852 | 0.4637 | 0.3468 | 0.3728 | 0.5279 | 0.6994 | 0.8105 | 0.8631 | (94) |
| Useful gains | 599.6113 | 688.9241 | 719.6186 | 704.3377 | 625.8187 | 481.9488 | 347.5583 | 358.6029 | 487.3997 | 573.5670 | 578.0537 | 573.1165 | (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 | 1363.1537 | 1353.1510 | 1249.9563 | 1066.4259 | 836.9530 | 573.4668 | 382.6802 | 400.7117 | 613.4353 | 897.0730 | 1147.1894 | 1352.0375 | (97) |
| Space heating kWh | 568.0756 | 446.3604 | 394.5713 | 260.7035 | 157.0840 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 240.6884 | 409.7777 | 579.5173 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3056.7781 | |
| 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 | 568.0756 | 446.3604 | 394.5713 | 260.7035 | 157.0840 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 240.6884 | 409.7777 | 579.5173 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3056.7781 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 38.4210 | (99) |

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

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| | | |
|---|---|---|
| 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 | 568.0756 | 446.3604 | 394.5713 | 260.7035 | 157.0840 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 240.6884 | 409.7777 | 579.5173 | (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) | 614.8004 | 483.0741 | 427.0252 | 282.1466 | 170.0043 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 260.4853 | 443.4824 | 627.1832 | (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 | 232.3062 | 205.4648 | 218.5663 | 193.1146 | 187.7808 | 169.8594 | 168.2274 | 174.6170 | 176.1865 | 195.6536 | 207.0071 | 229.9176 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.2199 | 85.9968 | 85.6308 | 85.0251 | 84.0014 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.8264 | 85.8154 | 86.2754 | (217) |
| Fuel for water heating, kWh/month | 269.4346 | 238.9214 | 255.2426 | 227.1266 | 223.5448 | 211.5311 | 209.4986 | 217.4558 | 219.4103 | 230.6517 | 241.2238 | 266.4926 | (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 | 22.8998 | 18.3711 | 16.5411 | 12.1187 | 9.3609 | 7.6479 | 8.5393 | 11.0997 | 14.4174 | 18.9164 | 21.3660 | 23.5362 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -15.0031 | -22.6728 | -34.9038 | -42.1194 | -47.9833 | -45.7303 | -45.1690 | -41.3519 | -35.1036 | -27.1456 | -17.0235 | -12.7996 | (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 | -4.4122 | -9.5628 | -19.5469 | -30.1745 | -40.7174 | -41.2199 | -40.7411 | -34.1211 | -24.5211 | -13.9429 | -5.9740 | -3.4689 | (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 | 3308.2014 | (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 | 2810.5339 | (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) | 184.8144 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -655.4087 | (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 | 5734.1410 | (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 | 3308.2014 | 0.2100 | 694.7223 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2810.5339 | 0.2100 | 590.2121 | (264) |
| Space and water heating | | | 1284.9344 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 184.8144 | 0.1443 | 26.6744 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -387.0060 | 0.1332 | -51.5344 | |
| PV Unit electricity exported | -268.4027 | 0.1251 | -33.5768 | |
| Total | | | -85.1113 | (269) |
| Total CO2, kg/year | | | 1238.4268 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.5700 | (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 | 3308.2014 | 1.1300 | 3738.2676 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2810.5339 | 1.1300 | 3175.9033 | (278) |
| Space and water heating | | | 6914.1709 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 184.8144 | 1.5338 | 283.4746 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -387.0060 | 1.4921 | -577.4370 | |
| PV Unit electricity exported | -268.4027 | 0.4592 | -123.2396 | |
| Total | | | -700.6766 | (283) |
| Total Primary energy kWh/year | | | 6627.0696 | (286) |
| Target Primary Energy Rate (TPER) | | | 83.3000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F3 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F3 | **Prop Type Ref** | F3 |
| **Property** | F3 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 15.63 | **TER** | 15.05 |
| **Environmental** | 87 B | **% DER < TER** | | | -3.85 |
| **$CO_2$ Emissions (t/year)** | 1.18 | **DFEE** | 33.69 | **TFEE** | 43.47 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 22.48 |
| **% DPER < TPER** | -7.67 | **DPER** | 86.67 | **TPER** | 80.50 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 82.2900 | (1b) | x 2.5000 | (2b) = | 205.7250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.2900 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 205.7250 | (5) |

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## 2. Ventilation rate

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| | 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) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1458 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3958 (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) = | 0.3365 (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 | 0.4290 | 0.4206 | 0.4122 | 0.3701 | 0.3617 | 0.3196 | 0.3196 | 0.3112 | 0.3365 | 0.3617 | 0.3785 | 0.3953 | (22b) |
| Effective ac | 0.5920 | 0.5884 | 0.5849 | 0.5685 | 0.5654 | 0.5511 | 0.5511 | 0.5484 | 0.5566 | 0.5654 | 0.5716 | 0.5781 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 78.2400 | 19.0000 | 59.2400 | 0.1500 | 8.8860 | 9.0000 | 533.1600 | (29a) |
| Communal Wall | 19.7000 | 2.1000 | 17.6000 | 0.1500 | 2.6400 | 9.0000 | 158.4000 | (29a) |
| External Roof | 82.2900 | | 82.2900 | 0.1000 | 8.2290 | 9.0000 | 740.6100 | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.2300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 43.6107 | | | (33) |
| Party Wall | | | 27.2000 | 0.0000 | 0.0000 | 20.0000 | 544.0000 | (32) |
| Party Floor | | | 82.2900 | | | 40.0000 | 3291.6000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6167.7700 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 74.9516 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 9.0115 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 52.6222 (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 | 40.1911 | 39.9486 | 39.7108 | 38.5941 | 38.3851 | 37.4125 | 37.4125 | 37.2324 | 37.7872 | 38.3851 | 38.8078 | 39.2497 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92.8134 | 92.5708 | 92.3330 | 91.2163 | 91.0074 | 90.0347 | 90.0347 | 89.8546 | 90.4094 | 91.0074 | 91.4300 | 91.8719 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 91.2153 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1279 | 1.1249 | 1.1220 | 1.1085 | 1.1059 | 1.0941 | 1.0941 | 1.0919 | 1.0987 | 1.1059 | 1.1111 | 1.1164 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1085 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.5049 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91.0501 | 89.6818 | 87.6879 | 83.8730 | 81.0576 | 77.9180 | 76.1334 | 78.1122 | 80.2814 | 83.6524 | 87.5493 | 90.7013 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28.5992 | 28.1745 | 27.5764 | 26.4736 | 25.6478 | 24.7321 | 24.2375 | 24.8315 | 25.4781 | 26.4579 | 27.5835 | 28.5026 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40.2824 | 38.8176 | 37.3528 | 35.8880 | 34.4232 | 32.9584 | 32.9584 | 34.4232 | 35.8880 | 37.3528 | 38.8176 | 40.2824 (42c) |

Average daily hot water use (litres/day) 147.0816 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 159.9318 | 156.6740 | 152.6171 | 146.2345 | 141.1286 | 135.6085 | 133.3293 | 137.3669 | 141.6475 | 147.4631 | 153.9504 | 159.4863 | (44) |
| Energy conte | 253.2929 | 223.1016 | 234.5668 | 200.1878 | 189.9862 | 166.7464 | 161.2502 | 170.0889 | 174.6655 | 200.1061 | 219.3305 | 249.7170 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2443.0400 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 37.9939 | 33.4652 | 35.1850 | 30.0282 | 28.4979 | 25.0120 | 24.1875 | 25.5133 | 26.1998 | 30.0159 | 32.8996 | 37.4575 | (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 | | | | | | | | | | | | | |
| | 304.2518 | 269.1290 | 285.5257 | 249.5028 | 240.9451 | 216.0615 | 212.2091 | 221.0478 | 223.9806 | 251.0650 | 268.6456 | 300.6759 | (62) |
| WWHRS | -25.8996 | -22.9058 | -23.9856 | -19.8610 | -18.5098 | -15.8390 | -14.8465 | -15.7878 | -16.3876 | -19.3192 | -21.8863 | -25.4200 | (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 | | | | | | | | | | | | | |
| | 278.3522 | 246.2232 | 261.5401 | 229.6418 | 222.4353 | 200.2226 | 197.3627 | 205.2600 | 207.5930 | 231.7458 | 246.7593 | 275.2559 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2802.3920 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2802 | (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 | | | | | | | | | | | | | |
| | 96.9596 | 85.6881 | 90.7332 | 78.8912 | 75.9101 | 67.7720 | 66.3554 | 69.2943 | 70.4051 | 79.2750 | 85.2562 | 95.7706 | (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 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 113.0629 | 125.1768 | 113.0629 | 116.8317 | 113.0629 | 116.8317 | 113.0629 | 113.0629 | 116.8317 | 113.0629 | 116.8317 | 113.0629 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 224.1599 | 226.4860 | 220.6244 | 208.1456 | 192.3934 | 177.5886 | 167.6981 | 165.3720 | 171.2337 | 183.7124 | 199.4646 | 214.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | (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) | | | | | | | | | | | | | |
| | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 130.3221 | 127.5121 | 121.9532 | 109.5711 | 102.0298 | 94.1277 | 89.1874 | 93.1375 | 97.7848 | 106.5524 | 118.4113 | 128.7240 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 531.1181 | 542.7481 | 519.2137 | 498.1216 | 471.0593 | 449.1212 | 430.5216 | 432.1456 | 446.4233 | 466.9009 | 498.2808 | 519.6294 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 775.3261 | 944.8917 | 1037.9991 | 1096.8700 | 1107.7633 | 1067.9627 | 1032.5450 | 1006.7729 | 992.4667 | 902.3651 | 788.1382 | 730.4033 | (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 | 18.4593 | 18.5077 | 18.5553 | 18.7825 | 18.8256 | 19.0290 | 19.0290 | 19.0671 | 18.9501 | 18.8256 | 18.7386 | 18.6485 | |
| alpha | 2.2306 | 2.2338 | 2.2370 | 2.2522 | 2.2550 | 2.2686 | 2.2686 | 2.2711 | 2.2633 | 2.2550 | 2.2492 | 2.2432 | |
| util living area | | | | | | | | | | | | | |
| | 0.8807 | 0.8285 | 0.7734 | 0.6947 | 0.5957 | 0.4689 | 0.3555 | 0.3767 | 0.5239 | 0.7091 | 0.8355 | 0.8921 | (86) |
| MIT | 18.4468 | 18.9141 | 19.4181 | 19.9857 | 20.4458 | 20.7746 | 20.9132 | 20.8981 | 20.6906 | 20.0891 | 19.1843 | 18.3618 | (87) |
| Th 2 | 19.9781 | 19.9805 | 19.9829 | 19.9939 | 19.9960 | 20.0056 | 20.0056 | 20.0074 | 20.0019 | 19.9960 | 19.9918 | 19.9874 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8680 | 0.8115 | 0.7512 | 0.6642 | 0.5533 | 0.4106 | 0.2834 | 0.3049 | 0.4673 | 0.6740 | 0.8163 | 0.8805 | (89) |
| MIT 2 | 17.6753 | 18.1257 | 18.6099 | 19.1527 | 19.5739 | 19.8616 | 19.9639 | 19.9561 | 19.7940 | 19.2623 | 18.4047 | 17.5994 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3739 | (91) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT | 17.9638 | 18.4205 | 18.9121 | 19.4642 | 19.8999 | 20.2030 | 20.3189 | 20.3083 | 20.1293 | 19.5714 | 18.6962 | 17.8844 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.8138 | 18.2705 | 18.7621 | 19.3142 | 19.7499 | 20.0530 | 20.1689 | 20.1583 | 19.9793 | 19.4214 | 18.5462 | 17.7344 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8344 | 0.7777 | 0.7205 | 0.6414 | 0.5422 | 0.4135 | 0.2957 | 0.3162 | 0.4660 | 0.6514 | 0.7833 | 0.8478 | (94) |
| Useful gains | 646.9351 | 734.8389 | 747.8887 | 703.5564 | 600.5880 | 441.5661 | 305.3047 | 318.3818 | 462.4640 | 587.8104 | 617.3234 | 619.2472 | (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 | | | | | | | | | | | | | |
| | 1254.2595 | 1237.7188 | 1132.1947 | 949.9407 | 732.6032 | 490.9586 | 321.3226 | 337.7020 | 531.5394 | 802.8165 | 1046.5283 | 1243.4348 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 451.8493 | 337.9353 | 285.9237 | 177.3967 | 98.2193 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 159.9645 | 309.0275 | 464.3956 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2284.7119 | |
| 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 | | | | | | | | | | | | | |
| | 451.8493 | 337.9353 | 285.9237 | 177.3967 | 98.2193 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 159.9645 | 309.0275 | 464.3956 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2284.7119 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 27.7641 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 %) | | | | | | | | | | | | 88.9000 | (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 | | | | | | | | | | | | | |
| | 451.8493 | 337.9353 | 285.9237 | 177.3967 | 98.2193 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 159.9645 | 309.0275 | 464.3956 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 508.2670 | 380.1297 | 321.6239 | 199.5463 | 110.4829 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.9376 | 347.6125 | 522.3798 | (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 | | | | | | | | | | | | | |
| | 278.3522 | 246.2232 | 261.5401 | 229.6418 | 222.4353 | 200.2226 | 197.3627 | 205.2600 | 207.5930 | 231.7458 | 246.7593 | 275.2559 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.4129 | 85.0602 | 84.5729 | 83.8345 | 82.7521 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.6028 | 84.8647 | 85.4926 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 325.8900 | 289.4693 | 309.2481 | 273.9227 | 268.7973 | 249.3432 | 245.7816 | 255.6165 | 258.5218 | 277.1988 | 290.7679 | 321.9646 | (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 | 23.7460 | 19.0500 | 17.1524 | 12.5666 | 9.7068 | 7.9305 | 8.8548 | 11.5099 | 14.9502 | 19.6154 | 22.1556 | 24.4060 | (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) | | | | | | | | | | | | | |
| (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 | 2569.9796 | (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 | 3366.5218 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 191.6441 | (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 | 6214.1455 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2569.9796 | 0.2100 | 539.6957 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |

| | | | | |
|---|---|---|---|---|
| Water heating (other fuel) | 3366.5218 | 0.2100 | 706.9696 | (264) |
| Space and water heating | | | 1246.6653 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 191.6441 | 0.1443 | 27.6602 | (268) |
| Total CO2, kg/year | | | 1286.2547 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.6300 | (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 | 2569.9796 | 1.1300 | 2904.0770 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3366.5218 | 1.1300 | 3804.1696 | (278) |
| Space and water heating | | | 6708.2466 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 191.6441 | 1.5338 | 293.9502 | (282) |
| Total Primary energy kWh/year | | | 7132.2975 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 86.6700 | (287) |

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

1. Overall dwelling characteristics

| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 82.2900 (1b) | x | 2.5000 (2b) | = | 205.7250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.2900 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 205.7250 | (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 | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1458 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3958 | (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) = | 0.3365 | (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 | 0.4290 | 0.4206 | 0.4122 | 0.3701 | 0.3617 | 0.3196 | 0.3196 | 0.3112 | 0.3365 | 0.3617 | 0.3785 | 0.3953 | (22b) |
| Effective ac | 0.5920 | 0.5884 | 0.5849 | 0.5685 | 0.5654 | 0.5511 | 0.5511 | 0.5484 | 0.5566 | 0.5654 | 0.5716 | 0.5781 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 18.4700 | 1.1450 | 21.1489 | | | (27) |
| External Wall | 78.2400 | 18.4700 | 59.7700 | 0.1800 | 10.7586 | | | (29a) |
| Communal Wall | 19.7000 | 2.1000 | 17.6000 | 0.1800 | 3.1680 | | | (29a) |
| External Roof | 82.2900 | | 82.2900 | 0.1100 | 9.0519 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.2300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.2274 | | | (33) |
| Party Wall | | | 27.2000 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 74.9516 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 11.3400 | 0.0500 | 0.5670 |
| E3 Sill | 6.0000 | 0.0500 | 0.3000 |
| E4 Jamb | 32.3700 | 0.0500 | 1.6185 |
| E7 Party floor between dwellings (in blocks of flats) | 33.7100 | 0.0700 | 2.3597 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.4600 | 0.0200 | 0.1092 |
| E14 Flat roof | 7.8800 | 0.0800 | 0.6304 |
| E15 Flat roof with parapet | 31.2900 | 0.5600 | 17.5224 |
| E16 Corner (normal) | 12.5000 | 0.0900 | 1.1250 |
| E17 Corner (inverted - internal area greater than external area) | 7.5000 | -0.0900 | -0.6750 |

| | | | | |
|---|---|---|---|---|
| E18 Party wall between dwellings | 10.0000 | 0.0600 | 0.6000 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 10.8800 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 10.8800 | 0.1200 | 1.3056 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4628 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 71.6902 (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 | 40.1911 | 39.9486 | 39.7108 | 38.5941 | 38.3851 | 37.4125 | 37.4125 | 37.2324 | 37.7872 | 38.3851 | 38.8078 | 39.2497 | (38) |
| Heat transfer coeff | 111.8813 | 111.6387 | 111.4010 | 110.2842 | 110.0753 | 109.1027 | 109.1027 | 108.9225 | 109.4773 | 110.0753 | 110.4980 | 110.9399 | (39) |

Average = Sum(39)m / 12 = 110.2832

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3596 | 1.3566 | 1.3538 | 1.3402 | 1.3377 | 1.3258 | 1.3258 | 1.3236 | 1.3304 | 1.3377 | 1.3428 | 1.3482 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3402 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.5049 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 66.2183 | 65.2231 | 63.7730 | 60.9985 | 58.9510 | 56.6676 | 55.3698 | 56.8089 | 58.3864 | 60.8381 | 63.6722 | 65.9646 | (42a) |
| Hot water usage for baths | 28.5992 | 28.1745 | 27.5764 | 26.4736 | 25.6478 | 24.7321 | 24.2375 | 24.8315 | 25.4781 | 26.4579 | 27.5835 | 28.5026 | (42b) |
| Hot water usage for other uses | 40.2824 | 38.8176 | 37.3528 | 35.8880 | 34.4232 | 32.9584 | 32.9584 | 34.4232 | 35.8880 | 37.3528 | 38.8176 | 40.2824 | (42c) |

Average daily hot water use (litres/day) 124.1874 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 135.1000 | 132.2153 | 128.7022 | 123.3601 | 119.0220 | 114.3581 | 112.5656 | 116.0635 | 119.7526 | 124.6488 | 130.0733 | 134.7496 | (44) |
| Energy conte | 213.9653 | 188.2728 | 197.8105 | 168.8738 | 160.2264 | 140.6166 | 136.1384 | 143.7109 | 147.6669 | 169.1473 | 185.3133 | 210.9853 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2062.7275 | |
| Distribution loss (46)m = 0.15 x (45)m | 32.0948 | 28.2409 | 29.6716 | 25.3311 | 24.0340 | 21.0925 | 20.4208 | 21.5566 | 22.1500 | 25.3721 | 27.7970 | 31.6478 | (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 | 264.9242 | 234.3002 | 248.7694 | 218.1889 | 211.1853 | 189.9317 | 187.0973 | 194.6698 | 196.9820 | 220.1062 | 234.6283 | 261.9442 | (62) |
| WWHRS | -30.2722 | -26.7730 | -28.0351 | -23.2142 | -21.6348 | -18.5131 | -17.3530 | -18.4532 | -19.1543 | -22.5808 | -25.5814 | -29.7116 | (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 | 234.6520 | 207.5272 | 220.7343 | 194.9746 | 189.5505 | 171.4186 | 169.7443 | 176.2166 | 177.8276 | 197.5254 | 209.0470 | 232.2325 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2381.4506 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2381 | (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 | 83.8832 | 74.1076 | 78.5117 | 68.4793 | 66.0150 | 59.0838 | 58.0057 | 60.5236 | 61.4280 | 68.9812 | 73.9454 | 82.8923 | (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 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 113.0504 | 125.1629 | 113.0504 | 116.8187 | 113.0504 | 116.8187 | 113.0504 | 113.0504 | 116.8187 | 113.0504 | 116.8187 | 113.0504 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 224.1599 | 226.4860 | 220.6244 | 208.1456 | 192.3934 | 177.5886 | 167.6981 | 165.3720 | 171.2337 | 183.7124 | 199.4646 | 214.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | (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) | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | (71) |
| Water heating gains (Table 5) | 112.7462 | 110.2791 | 105.5265 | 95.1101 | 88.7299 | 82.0608 | 77.9647 | 81.3489 | 85.3167 | 92.7167 | 102.7020 | 111.4144 | (72) |
| Total internal gains | 513.5297 | 525.5012 | 502.7744 | 483.6477 | 457.7469 | 437.0414 | 419.2864 | 420.3445 | 433.9422 | 453.0526 | 482.5585 | 502.3074 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4000 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 7.7993 | (74) |
| South | 16.0700 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 229.6088 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 237.4081 | 390.9449 | 504.3352 | 582.0649 | 618.9568 | 601.5893 | 585.2413 | 558.6136 | 530.8319 | 423.3367 | 281.7861 | 204.9050 | (83) |
| Total gains | 750.9378 | 916.4461 | 1007.1097 | 1065.7126 | 1076.7036 | 1038.6307 | 1004.5277 | 978.9581 | 964.7742 | 876.3893 | 764.3446 | 707.2124 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 15.3133 | 15.3466 | 15.3793 | 15.5350 | 15.5645 | 15.7033 | 15.7033 | 15.7292 | 15.6495 | 15.5645 | 15.5050 | 15.4432 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| alpha | 2.0209 | 2.0231 | 2.0253 | 2.0357 | 2.0376 | 2.0469 | 2.0469 | 2.0486 | 2.0433 | 2.0376 | 2.0337 | 2.0295 | |
| util living area | 0.8988 | 0.8557 | 0.8098 | 0.7425 | 0.6537 | 0.5330 | 0.4164 | 0.4390 | 0.5867 | 0.7553 | 0.8618 | 0.9083 | (86) |
| MIT | 17.7928 | 18.2744 | 18.8462 | 19.5294 | 20.1333 | 20.6062 | 20.8317 | 20.8058 | 20.4853 | 19.6914 | 18.6276 | 17.7033 | (87) |
| Th 2 | 19.7944 | 19.7967 | 19.7990 | 19.8095 | 19.8115 | 19.8207 | 19.8207 | 19.8224 | 19.8171 | 19.8115 | 19.8075 | 19.8033 | (88) |
| util rest of house | 0.8864 | 0.8390 | 0.7873 | 0.7103 | 0.6064 | 0.4622 | 0.3222 | 0.3463 | 0.5202 | 0.7183 | 0.8429 | 0.8970 | (89) |
| MIT 2 | 16.1468 | 16.7386 | 17.4409 | 18.2728 | 18.9839 | 19.5102 | 19.7245 | 19.7054 | 19.3880 | 18.4859 | 17.1932 | 16.0391 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3739 | (91) |
| MIT | 16.7623 | 17.3128 | 17.9664 | 18.7427 | 19.4137 | 19.9200 | 20.1385 | 20.1169 | 19.7983 | 18.9367 | 17.7295 | 16.6614 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.7623 | 17.3128 | 17.9664 | 18.7427 | 19.4137 | 19.9200 | 20.1385 | 20.1169 | 19.7983 | 18.9367 | 17.7295 | 16.6614 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8438 | 0.7944 | 0.7451 | 0.6767 | 0.5887 | 0.4686 | 0.3490 | 0.3709 | 0.5190 | 0.6861 | 0.7999 | 0.8558 | (94) |
| Useful gains | 633.6298 | 728.0058 | 750.3839 | 721.1984 | 633.8219 | 486.6942 | 350.5679 | 363.1256 | 500.7257 | 601.2930 | 611.3686 | 605.1994 | (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 | 1394.2974 | 1385.7519 | 1277.3660 | 1085.4903 | 849.0878 | 580.4306 | 386.0629 | 404.8528 | 623.8385 | 917.6616 | 1174.5404 | 1382.4637 | (97) |
| Space heating kWh | 565.9367 | 442.0054 | 392.0747 | 262.2902 | 160.1578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 235.3782 | 405.4837 | 578.2846 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3041.6115 | |
| 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 | 565.9367 | 442.0054 | 392.0747 | 262.2902 | 160.1578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 235.3782 | 405.4837 | 578.2846 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3041.6115 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 36.9621 | (99) |

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

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| | | |
|---|---|---|
| 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 | 565.9367 | 442.0054 | 392.0747 | 262.2902 | 160.1578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 235.3782 | 405.4837 | 578.2846 | (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) | 612.4856 | 478.3608 | 424.3233 | 283.8638 | 173.3310 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 254.7383 | 438.8352 | 625.8492 | (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 | 234.6520 | 207.5272 | 220.7343 | 194.9746 | 189.5505 | 171.4186 | 169.7443 | 176.2166 | 177.8276 | 197.5254 | 209.0470 | 232.2325 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.1943 | 85.9587 | 85.5979 | 85.0176 | 84.0225 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.7581 | 85.7750 | 86.2532 | (217) |
| Fuel for water heating, kWh/month | 272.2360 | 241.4268 | 257.8735 | 229.3345 | 225.5950 | 213.4728 | 211.3876 | 219.4478 | 221.4541 | 233.0459 | 243.7154 | 269.2451 | (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 | 23.4896 | 18.8443 | 16.9672 | 12.4309 | 9.6020 | 7.8449 | 8.7592 | 11.3856 | 14.7887 | 19.4036 | 21.9164 | 24.1425 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -15.4974 | -23.4086 | -36.0188 | -43.4419 | -49.4683 | -47.1360 | -46.5557 | -42.6311 | -36.2046 | -28.0154 | -17.5800 | -13.2224 | (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 | -4.5841 | -9.9332 | -20.3004 | -31.3326 | -42.2761 | -42.7978 | -42.3022 | -35.4317 | -25.4660 | -14.4829 | -6.2066 | -3.6043 | (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 | 3291.7873 | (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 | 2838.2344 | (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) | 189.5748 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -677.8982 | (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 | 5727.6983 | (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 | 3291.7873 | 0.2100 | 691.2753 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2838.2344 | 0.2100 | 596.0292 | (264) |
| Space and water heating | | | 1287.3046 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 189.5748 | 0.1443 | 27.3615 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -399.1803 | 0.1332 | -53.1599 | |
| PV Unit electricity exported | -278.7179 | 0.1251 | -34.8682 | |
| Total | | | -88.0282 | (269) |
| Total CO2, kg/year | | | 1238.5672 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.0500 | (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 | 3291.7873 | 1.1300 | 3719.7196 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2838.2344 | 1.1300 | 3207.2049 | (278) |
| Space and water heating | | | 6926.9245 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 189.5748 | 1.5338 | 290.7762 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -399.1803 | 1.4921 | -595.6181 | |
| PV Unit electricity exported | -278.7179 | 0.4592 | -127.9796 | |
| Total | | | -723.5977 | (283) |
| Total Primary energy kWh/year | | | 6624.2039 | (286) |
| Target Primary Energy Rate (TPER) | | | 80.5000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F3 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F3 | **Prop Type Ref** | F3 |
| **Property** | F3 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 15.63 | **TER** | 15.05 |
| **Environmental** | 87 B | **% DER < TER** | | | -3.85 |
| **$CO_2$ Emissions (t/year)** | 1.18 | **DFEE** | 33.69 | **TFEE** | 43.47 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 22.48 |
| **% DPER < TPER** | -7.67 | **DPER** | 86.67 | **TPER** | 80.50 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 82.2900 | (1b) | x 2.5000 | (2b) = | 205.7250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.2900 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 205.7250 | (5) |

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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) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1458 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3958 | (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) = | 0.3365 | (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 | 0.4290 | 0.4206 | 0.4122 | 0.3701 | 0.3617 | 0.3196 | 0.3196 | 0.3112 | 0.3365 | 0.3617 | 0.3785 | 0.3953 | (22b) |

| | | |
|---|---|---|
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5920 | 0.5884 | 0.5849 | 0.5685 | 0.5654 | 0.5511 | 0.5511 | 0.5484 | 0.5566 | 0.5654 | 0.5716 | 0.5781 | (25) |

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3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 78.2400 | 19.0000 | 59.2400 | 0.1500 | 8.8860 | 9.0000 | 533.1600 | (29a) |
| Communal Wall | 19.7000 | 2.1000 | 17.6000 | 0.1500 | 2.6400 | 9.0000 | 158.4000 | (29a) |
| External Roof | 82.2900 | | 82.2900 | 0.1000 | 8.2290 | 9.0000 | 740.6100 | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.2300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 43.6107 | | | (33) |
| Party Wall | | | 27.2000 | 0.0000 | 0.0000 | 20.0000 | 544.0000 | (32) |
| Party Floor | | | 82.2900 | | | 40.0000 | 3291.6000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6167.7700 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 74.9516 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 9.0115 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 52.6222 (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 | 40.1911 | 39.9486 | 39.7108 | 38.5941 | 38.3851 | 37.4125 | 37.4125 | 37.2324 | 37.7872 | 38.3851 | 38.8078 | 39.2497 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 92.8134 | 92.5708 | 92.3330 | 91.2163 | 91.0074 | 90.0347 | 90.0347 | 89.8546 | 90.4094 | 91.0074 | 91.4300 | 91.8719 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 91.2153 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1279 | 1.1249 | 1.1220 | 1.1085 | 1.1059 | 1.0941 | 1.0941 | 1.0919 | 1.0987 | 1.1059 | 1.1111 | 1.1164 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1085 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.5049 | (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 | | | | | | | | | | | | | |
| | 28.5992 | 28.1745 | 27.5764 | 26.4736 | 25.6478 | 24.7321 | 24.2375 | 24.8315 | 25.4781 | 26.4579 | 27.5835 | 28.5026 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 40.2824 | 38.8176 | 37.3528 | 35.8880 | 34.4232 | 32.9584 | 32.9584 | 34.4232 | 35.8880 | 37.3528 | 38.8176 | 40.2824 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 63.1364 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 68.8817 | 66.9921 | 64.9292 | 62.3616 | 60.0710 | 57.6905 | 57.1959 | 59.2546 | 61.3661 | 63.8107 | 66.4011 | 68.7850 | (44) |
| Energy conte | 109.0918 | 95.3959 | 99.7938 | 85.3699 | 80.8671 | 70.9372 | 69.1735 | 73.3696 | 75.6706 | 86.5906 | 94.6005 | 107.7007 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1048.5610 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 92.7280 | 81.0865 | 84.8247 | 72.5644 | 68.7370 | 60.2966 | 58.7974 | 62.3642 | 64.3200 | 73.6020 | 80.4105 | 91.5456 | (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 | | | | | | | | | | | | | |
| | 92.7280 | 81.0865 | 84.8247 | 72.5644 | 68.7370 | 60.2966 | 58.7974 | 62.3642 | 64.3200 | 73.6020 | 80.4105 | 91.5456 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 891.2768 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 891 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 53.0298 | 47.2500 | 51.5952 | 49.2366 | 50.1606 | 47.8483 | 49.4432 | 50.1606 | 49.2366 | 51.5952 | 50.6250 | 53.0298 | (64a) |
| | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | 603.2109 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 36.4394 | 32.0841 | 34.1050 | 30.4503 | 29.7244 | 27.0362 | 27.0602 | 28.1312 | 28.3892 | 31.2993 | 32.7589 | 36.1438 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 113.0629 | 125.1768 | 113.0629 | 116.8317 | 113.0629 | 116.8317 | 113.0629 | 113.0629 | 116.8317 | 113.0629 | 116.8317 | 113.0629 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 224.1599 | 226.4860 | 220.6244 | 208.1456 | 192.3934 | 177.5886 | 167.6981 | 165.3720 | 171.2337 | 183.7124 | 199.4646 | 214.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | (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) | | | | | | | | | | | | | |
| | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 48.9778 | 47.7442 | 45.8400 | 42.2920 | 39.9521 | 37.5503 | 36.3712 | 37.8107 | 39.4294 | 42.0689 | 45.4984 | 48.5804 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 446.7738 | 459.9802 | 440.1005 | 427.8425 | 405.9817 | 392.5438 | 377.7054 | 376.8188 | 388.0679 | 399.4174 | 422.3679 | 436.4859 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 690.9818 | 862.1239 | 958.8859 | 1026.5910 | 1042.6856 | 1011.3853 | 979.7288 | 951.4462 | 934.1113 | 834.8817 | 712.2253 | 647.2598 | (84) |

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7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 18.4593 | 18.5077 | 18.5553 | 18.7825 | 18.8256 | 19.0290 | 19.0290 | 19.0671 | 18.9501 | 18.8256 | 18.7386 | 18.6485 | |
| alpha | 2.2306 | 2.2338 | 2.2370 | 2.2522 | 2.2550 | 2.2686 | 2.2686 | 2.2711 | 2.2633 | 2.2550 | 2.2492 | 2.2432 | |
| util living area | | | | | | | | | | | | | |
| | 0.9013 | 0.8504 | 0.7964 | 0.7172 | 0.6180 | 0.4884 | 0.3718 | 0.3948 | 0.5463 | 0.7350 | 0.8590 | 0.9121 | (86) |
| MIT | 18.2701 | 18.7678 | 19.3024 | 19.9094 | 20.3999 | 20.7544 | 20.9047 | 20.8875 | 20.6618 | 20.0110 | 19.0460 | 18.1806 | (87) |
| Th 2 | 19.9781 | 19.9805 | 19.9829 | 19.9939 | 19.9960 | 20.0056 | 20.0056 | 20.0074 | 20.0019 | 19.9960 | 19.9918 | 19.9874 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8904 | 0.8350 | 0.7754 | 0.6875 | 0.5758 | 0.4289 | 0.2972 | 0.3206 | 0.4890 | 0.7010 | 0.8418 | 0.9022 | (89) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT 2 | 17.5052 | 17.9873 | 18.5030 | 19.0853 | 19.5365 | 19.8477 | 19.9595 | 19.9504 | 19.7732 | 19.1943 | 18.2747 | 17.4243 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3739 | (91) |
| MIT | 17.7912 | 18.2791 | 18.8019 | 19.3934 | 19.8593 | 20.1867 | 20.3130 | 20.3008 | 20.1054 | 19.4997 | 18.5631 | 17.7071 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.7912 | 18.2791 | 18.8019 | 19.3934 | 19.8593 | 20.1867 | 20.3130 | 20.3008 | 20.1054 | 19.4997 | 18.5631 | 17.7071 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8606 | 0.8039 | 0.7473 | 0.6679 | 0.5696 | 0.4403 | 0.3210 | 0.3433 | 0.4953 | 0.6822 | 0.8120 | 0.8736 | (94) |
| Useful gains | 594.6486 | 693.1041 | 716.5421 | 685.6992 | 593.9084 | 445.2742 | 314.4969 | 326.6773 | 462.7017 | 569.5667 | 578.3482 | 565.4390 | (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 | 1252.1667 | 1238.5160 | 1135.8751 | 957.1730 | 742.5573 | 503.0013 | 334.2946 | 350.5033 | 542.9474 | 809.9381 | 1048.0705 | 1240.9222 | (97) |
| Space heating kWh | 489.1934 | 366.5168 | 311.9838 | 195.4611 | 110.5947 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 178.8363 | 338.2001 | 502.5595 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2493.3457 | |
| 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 | 489.1934 | 366.5168 | 311.9838 | 195.4611 | 110.5947 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 178.8363 | 338.2001 | 502.5595 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2493.3457 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 30.2995 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 846.3265 | 666.2570 | 682.8951 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7890 | 0.8439 | 0.8312 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 667.7489 | 562.2464 | 567.6109 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1138.4534 | 1103.6515 | 1072.8029 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 338.9073 | 402.8054 | 375.8629 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 84.7268 | 100.7013 | 93.9657 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 279.3939 | (107) |
| Energy for space heating | | | | | | | | | | | | 30.2995 | (99) |
| Energy for space cooling | | | | | | | | | | | | 3.3952 | (108) |
| Total | | | | | | | | | | | | 33.6947 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 33.7 | (109) |

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

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 82.2900 | (1b) | x 2.5000 | (2b) = | 205.7250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.2900 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 205.7250 | (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 | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1458 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3958 | (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) = | 0.3365 | (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 | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.4290 | 0.4206 | 0.4122 | 0.3701 | 0.3617 | 0.3196 | 0.3196 | 0.3112 | 0.3365 | 0.3617 | 0.3785 | 0.3953 | (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.0000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 0.0000 | (23c) |
| Effective ac | 0.5920 | 0.5884 | 0.5849 | 0.5685 | 0.5654 | 0.5511 | 0.5511 | 0.5484 | 0.5566 | 0.5654 | 0.5716 | 0.5781 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 18.4700 | 1.1450 | 21.1489 | | | (27) |
| External Wall | 78.2400 | 18.4700 | 59.7700 | 0.1800 | 10.7586 | | | (29a) |
| Communal Wall | 19.7000 | 2.1000 | 17.6000 | 0.1800 | 3.1680 | | | (29a) |
| External Roof | 82.2900 | | 82.2900 | 0.1100 | 9.0519 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.2300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 46.2274 | | | (33) |
| Party Wall | | | 27.2000 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 74.9516 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 11.3400 | 0.0500 | 0.5670 |
| E3 Sill | 6.0000 | 0.0500 | 0.3000 |
| E4 Jamb | 32.3700 | 0.0500 | 1.6185 |
| E7 Party floor between dwellings (in blocks of flats) | 33.7100 | 0.0700 | 2.3597 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.4600 | 0.0200 | 0.1092 |
| E14 Flat roof | 7.8800 | 0.0800 | 0.6304 |
| E15 Flat roof with parapet | 31.2900 | 0.5600 | 17.5224 |
| E16 Corner (normal) | 12.5000 | 0.0900 | 1.1250 |
| E17 Corner (inverted - internal area greater than external area) | 7.5000 | -0.0900 | -0.6750 |
| E18 Party wall between dwellings | 10.0000 | 0.0600 | 0.6000 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 10.8800 | 0.0000 | 0.0000 |
| P4 Party wall - Roof (insulation at ceiling level) | 10.8800 | 0.1200 | 1.3056 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4628 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 71.6902 (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 | 40.1911 | 39.9486 | 39.7108 | 38.5941 | 38.3851 | 37.4125 | 37.4125 | 37.2324 | 37.7872 | 38.3851 | 38.8078 | 39.2497 | (38) |
| Heat transfer coeff | 111.8813 | 111.6387 | 111.4010 | 110.2842 | 110.0753 | 109.1027 | 109.1027 | 108.9225 | 109.4773 | 110.0753 | 110.4980 | 110.9399 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 110.2832 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3596 | 1.3566 | 1.3538 | 1.3402 | 1.3377 | 1.3258 | 1.3258 | 1.3236 | 1.3304 | 1.3377 | 1.3428 | 1.3482 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3402 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

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Assumed occupancy 2.5049 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.5992 | 28.1745 | 27.5764 | 26.4736 | 25.6478 | 24.7321 | 24.2375 | 24.8315 | 25.4781 | 26.4579 | 27.5835 | 28.5026 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.2824 | 38.8176 | 37.3528 | 35.8880 | 34.4232 | 32.9584 | 32.9584 | 34.4232 | 35.8880 | 37.3528 | 38.8176 | 40.2824 | (42c) |

Average daily hot water use (litres/day) 63.1364 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 68.8817 | 66.9921 | 64.9292 | 62.3616 | 60.0710 | 57.6905 | 57.1959 | 59.2546 | 61.3661 | 63.8107 | 66.4011 | 68.7850 | (44) |
| Energy conte | 109.0918 | 95.3959 | 99.7938 | 85.3699 | 80.8671 | 70.9372 | 69.1735 | 73.3696 | 75.6706 | 86.5906 | 94.6005 | 107.7007 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1048.5610 | |
| Distribution loss (46)m = 0.15 x (45)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 92.7280 | 81.0865 | 84.8247 | 72.5644 | 68.7370 | 60.2966 | 58.7974 | 62.3642 | 64.3200 | 73.6020 | 80.4105 | 91.5456 | (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 | 92.7280 | 81.0865 | 84.8247 | 72.5644 | 68.7370 | 60.2966 | 58.7974 | 62.3642 | 64.3200 | 73.6020 | 80.4105 | 91.5456 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 891.2768 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 891 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53.0298 | 47.2500 | 51.5952 | 49.2366 | 50.1606 | 47.8483 | 49.4432 | 50.1606 | 49.2366 | 51.5952 | 50.6250 | 53.0298 | (64a) |
| | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 603.2109 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36.4394 | 32.0841 | 34.1050 | 30.4503 | 29.7244 | 27.0362 | 27.0602 | 28.1312 | 28.3892 | 31.2993 | 32.7589 | 36.1438 | (65) |

---

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 113.0504 | 125.1629 | 113.0504 | 116.8187 | 113.0504 | 116.8187 | 113.0504 | 113.0504 | 116.8187 | 113.0504 | 116.8187 | 113.0504 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 224.1599 | 226.4860 | 220.6244 | 208.1456 | 192.3934 | 177.5886 | 167.6981 | 165.3720 | 171.2337 | 183.7124 | 199.4646 | 214.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | (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) | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | (71) |
| Water heating gains (Table 5) | 48.9778 | 47.7442 | 45.8400 | 42.2920 | 39.9521 | 37.5503 | 36.3712 | 37.8107 | 39.4294 | 42.0689 | 45.4984 | 48.5804 | (72) |
| Total internal gains | 446.7612 | 459.9663 | 440.0879 | 427.8295 | 405.9691 | 392.5308 | 377.6928 | 376.8063 | 388.0549 | 399.4049 | 422.3549 | 436.4734 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4000 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 7.7993 | (74) |
| South | 16.0700 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 229.6088 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 237.4081 | 390.9449 | 504.3352 | 582.0649 | 618.9568 | 601.5893 | 585.2413 | 558.6136 | 530.8319 | 423.3367 | 281.7861 | 204.9050 | (83) |
| Total gains | 684.1693 | 850.9112 | 944.4232 | 1009.8945 | 1024.9259 | 994.1202 | 962.9342 | 935.4199 | 918.8869 | 822.7416 | 704.1410 | 641.3784 | (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 | 15.3133 | 15.3466 | 15.3793 | 15.5350 | 15.5645 | 15.7033 | 15.7033 | 15.7292 | 15.6495 | 15.5645 | 15.5050 | 15.4432 | |
| alpha | 2.0209 | 2.0231 | 2.0253 | 2.0357 | 2.0376 | 2.0469 | 2.0469 | 2.0486 | 2.0433 | 2.0376 | 2.0337 | 2.0295 | |
| util living area | 0.9126 | 0.8705 | 0.8255 | 0.7584 | 0.6704 | 0.5485 | 0.4302 | 0.4543 | 0.6038 | 0.7734 | 0.8776 | 0.9216 | (86) |
| MIT | 17.6570 | 18.1573 | 18.7494 | 19.4608 | 20.0878 | 20.5835 | 20.8209 | 20.7926 | 20.4551 | 19.6221 | 18.5173 | 17.5650 | (87) |
| Th 2 | 19.7944 | 19.7967 | 19.7990 | 19.8095 | 19.8115 | 19.8207 | 19.8207 | 19.8224 | 19.8171 | 19.8115 | 19.8075 | 19.8033 | (88) |
| util rest of house | 0.9016 | 0.8550 | 0.8042 | 0.7272 | 0.6236 | 0.4771 | 0.3340 | 0.3598 | 0.5373 | 0.7379 | 0.8603 | 0.9117 | (89) |
| MIT 2 | 16.7937 | 17.2799 | 17.8544 | 18.5405 | 19.1238 | 19.5614 | 19.7397 | 19.7236 | 19.4580 | 18.7088 | 17.6482 | 16.7095 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3739 | (91) |
| MIT | 17.1165 | 17.6080 | 18.1891 | 18.8846 | 19.4843 | 19.9436 | 20.1440 | 20.1233 | 19.8308 | 19.0503 | 17.9732 | 17.0294 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.1165 | 17.6080 | 18.1891 | 18.8846 | 19.4843 | 19.9436 | 20.1440 | 20.1233 | 19.8308 | 19.0503 | 17.9732 | 17.0294 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8688 | 0.8192 | 0.7694 | 0.6991 | 0.6092 | 0.4852 | 0.3620 | 0.3855 | 0.5382 | 0.7110 | 0.8259 | 0.8803 | (94) |
| Useful gains | 594.3755 | 697.0286 | 726.6304 | 706.0365 | 624.3900 | 482.3254 | 348.5482 | 360.5743 | 494.5392 | 584.9560 | 581.5826 | 564.6328 | (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 | 1433.9242 | 1418.7059 | 1302.1739 | 1101.1467 | 856.8582 | 582.9992 | 386.6601 | 405.5564 | 627.3969 | 930.1720 | 1201.4635 | 1423.2910 | (97) |
| Space heating kWh | 624.6242 | 484.9672 | 428.2044 | 284.4793 | 172.9563 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 256.8407 | 446.3143 | 638.8416 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3337.2281 | |
| 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 | 624.6242 | 484.9672 | 428.2044 | 284.4793 | 172.9563 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 256.8407 | 446.3143 | 638.8416 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3337.2281 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 40.5545 | (99) |

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8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1025.5650 | 807.3597 | 827.8113 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7004 | 0.7644 | 0.7490 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 718.2998 | 617.1142 | 620.0266 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1118.2875 | 1084.0349 | 1054.0841 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 287.9911 | 347.3890 | 322.9387 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 71.9978 | 86.8472 | 80.7347 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 239.5797 | (107) |
| Energy for space heating | | | | | | | | | | | | 40.5545 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.9114 | (108) |
| Total | | | | | | | | | | | | 43.4659 | (109) |
| Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 43.5 | (109) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F3 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F3 | **Prop Type Ref** | F3 |
| **Property** | F3 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 15.63 | **TER** | 15.05 |
| **Environmental** | 87 B | **% DER < TER** | | | -3.85 |
| **$CO_2$ Emissions (t/year)** | 1.18 | **DFEE** | 33.69 | **TFEE** | 43.47 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 22.48 |
| **% DPER < TPER** | -7.67 | **DPER** | 86.67 | **TPER** | 80.50 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 82.2900 | (1b) | x 2.5000 | (2b) = | 205.7250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.2900 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 205.7250 | (5) |

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## 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) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1458 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3958 (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) = | 0.3365 (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 | 0.4290 | 0.4206 | 0.4122 | 0.3701 | 0.3617 | 0.3196 | 0.3196 | 0.3112 | 0.3365 | 0.3617 | 0.3785 | 0.3953 | (22b) |
| Effective ac | 0.5920 | 0.5884 | 0.5849 | 0.5685 | 0.5654 | 0.5511 | 0.5511 | 0.5484 | 0.5566 | 0.5654 | 0.5716 | 0.5781 | (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 78.2400 | 19.0000 | 59.2400 | 0.1500 | 8.8860 | 9.0000 | 533.1600 | (29a) |
| Communal Wall | 19.7000 | 2.1000 | 17.6000 | 0.1500 | 2.6400 | 9.0000 | 158.4000 | (29a) |
| External Roof | 82.2900 | | 82.2900 | 0.1000 | 8.2290 | 9.0000 | 740.6100 | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.2300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 43.6107 | | | (33) |
| Party Wall | | | 27.2000 | 0.0000 | 0.0000 | 20.0000 | 544.0000 | (32) |
| Party Floor | | | 82.2900 | | | 40.0000 | 3291.6000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6167.7700 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 74.9516 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 9.0115 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 52.6222 (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 | 40.1911 | 39.9486 | 39.7108 | 38.5941 | 38.3851 | 37.4125 | 37.4125 | 37.2324 | 37.7872 | 38.3851 | 38.8078 | 39.2497 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92.8134 | 92.5708 | 92.3330 | 91.2163 | 91.0074 | 90.0347 | 90.0347 | 89.8546 | 90.4094 | 91.0074 | 91.4300 | 91.8719 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 91.2153 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1279 | 1.1249 | 1.1220 | 1.1085 | 1.1059 | 1.0941 | 1.0941 | 1.0919 | 1.0987 | 1.1059 | 1.1111 | 1.1164 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1085 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.5049 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91.0501 | 89.6818 | 87.6879 | 83.8730 | 81.0576 | 77.9180 | 76.1334 | 78.1122 | 80.2814 | 83.6524 | 87.5493 | 90.7013 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28.5992 | 28.1745 | 27.5764 | 26.4736 | 25.6478 | 24.7321 | 24.2375 | 24.8315 | 25.4781 | 26.4579 | 27.5835 | 28.5026 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40.2824 | 38.8176 | 37.3528 | 35.8880 | 34.4232 | 32.9584 | 32.9584 | 34.4232 | 35.8880 | 37.3528 | 38.8176 | 40.2824 (42c) |

Average daily hot water use (litres/day) 147.0816 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 159.9318 | 156.6740 | 152.6171 | 146.2345 | 141.1286 | 135.6085 | 133.3293 | 137.3669 | 141.6475 | 147.4631 | 153.9504 | 159.4863 | (44) |
| Energy conte | 253.2929 | 223.1016 | 234.5668 | 200.1878 | 189.9862 | 166.7464 | 161.2502 | 170.0889 | 174.6655 | 200.1061 | 219.3305 | 249.7170 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2443.0400 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 37.9939 | 33.4652 | 35.1850 | 30.0282 | 28.4979 | 25.0120 | 24.1875 | 25.5133 | 26.1998 | 30.0159 | 32.8996 | 37.4575 | (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 | | | | | | | | | | | | | |
| | 304.2518 | 269.1290 | 285.5257 | 249.5028 | 240.9451 | 216.0615 | 212.2091 | 221.0478 | 223.9806 | 251.0650 | 268.6456 | 300.6759 | (62) |
| WWHRS | -25.8996 | -22.9058 | -23.9856 | -19.8610 | -18.5098 | -15.8390 | -14.8465 | -15.7878 | -16.3876 | -19.3192 | -21.8863 | -25.4200 | (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 | | | | | | | | | | | | | |
| | 278.3522 | 246.2232 | 261.5401 | 229.6418 | 222.4353 | 200.2226 | 197.3627 | 205.2600 | 207.5930 | 231.7458 | 246.7593 | 275.2559 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2802.3920 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2802 | (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 | | | | | | | | | | | | | |
| | 96.9596 | 85.6881 | 90.7332 | 78.8912 | 75.9101 | 67.7720 | 66.3554 | 69.2943 | 70.4051 | 79.2750 | 85.2562 | 95.7706 | (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 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 113.0629 | 125.1768 | 113.0629 | 116.8317 | 113.0629 | 116.8317 | 113.0629 | 113.0629 | 116.8317 | 113.0629 | 116.8317 | 113.0629 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 224.1599 | 226.4860 | 220.6244 | 208.1456 | 192.3934 | 177.5886 | 167.6981 | 165.3720 | 171.2337 | 183.7124 | 199.4646 | 214.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | (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) | | | | | | | | | | | | | |
| | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 130.3221 | 127.5121 | 121.9532 | 109.5711 | 102.0298 | 94.1277 | 89.1874 | 93.1375 | 97.7848 | 106.5524 | 118.4113 | 128.7240 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 531.1181 | 542.7481 | 519.2137 | 498.1216 | 471.0593 | 449.1212 | 430.5216 | 432.1456 | 446.4233 | 466.9009 | 498.2808 | 519.6294 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 775.3261 | 944.8917 | 1037.9991 | 1096.8700 | 1107.7633 | 1067.9627 | 1032.5450 | 1006.7729 | 992.4667 | 902.3651 | 788.1382 | 730.4033 | (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 | 18.4593 | 18.5077 | 18.5553 | 18.7825 | 18.8256 | 19.0290 | 19.0290 | 19.0671 | 18.9501 | 18.8256 | 18.7386 | 18.6485 | |
| alpha | 2.2306 | 2.2338 | 2.2370 | 2.2522 | 2.2550 | 2.2686 | 2.2686 | 2.2711 | 2.2633 | 2.2550 | 2.2492 | 2.2432 | |
| util living area | | | | | | | | | | | | | |
| | 0.8807 | 0.8285 | 0.7734 | 0.6947 | 0.5957 | 0.4689 | 0.3555 | 0.3767 | 0.5239 | 0.7091 | 0.8355 | 0.8921 | (86) |
| MIT | 18.4468 | 18.9141 | 19.4181 | 19.9857 | 20.4458 | 20.7746 | 20.9132 | 20.8981 | 20.6906 | 20.0891 | 19.1843 | 18.3618 | (87) |
| Th 2 | 19.9781 | 19.9805 | 19.9829 | 19.9939 | 19.9960 | 20.0056 | 20.0056 | 20.0074 | 20.0019 | 19.9960 | 19.9918 | 19.9874 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8680 | 0.8115 | 0.7512 | 0.6642 | 0.5533 | 0.4106 | 0.2834 | 0.3049 | 0.4673 | 0.6740 | 0.8163 | 0.8805 | (89) |
| MIT 2 | 17.6753 | 18.1257 | 18.6099 | 19.1527 | 19.5739 | 19.8616 | 19.9639 | 19.9561 | 19.7940 | 19.2623 | 18.4047 | 17.5994 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3739 | (91) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT | 17.9638 | 18.4205 | 18.9121 | 19.4642 | 19.8999 | 20.2030 | 20.3189 | 20.3083 | 20.1293 | 19.5714 | 18.6962 | 17.8844 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.8138 | 18.2705 | 18.7621 | 19.3142 | 19.7499 | 20.0530 | 20.1689 | 20.1583 | 19.9793 | 19.4214 | 18.5462 | 17.7344 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8344 | 0.7777 | 0.7205 | 0.6414 | 0.5422 | 0.4135 | 0.2957 | 0.3162 | 0.4660 | 0.6514 | 0.7833 | 0.8478 | (94) |
| Useful gains | 646.9351 | 734.8389 | 747.8887 | 703.5564 | 600.5880 | 441.5661 | 305.3047 | 318.3818 | 462.4640 | 587.8104 | 617.3234 | 619.2472 | (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 | | | | | | | | | | | | | |
| | 1254.2595 | 1237.7188 | 1132.1947 | 949.9407 | 732.6032 | 490.9586 | 321.3226 | 337.7020 | 531.5394 | 802.8165 | 1046.5283 | 1243.4348 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 451.8493 | 337.9353 | 285.9237 | 177.3967 | 98.2193 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 159.9645 | 309.0275 | 464.3956 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2284.7119 | |
| 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 | | | | | | | | | | | | | |
| | 451.8493 | 337.9353 | 285.9237 | 177.3967 | 98.2193 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 159.9645 | 309.0275 | 464.3956 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2284.7119 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 27.7641 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 %) | | | | | | | | | | | | 88.9000 | (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 | | | | | | | | | | | | | |
| | 451.8493 | 337.9353 | 285.9237 | 177.3967 | 98.2193 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 159.9645 | 309.0275 | 464.3956 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 508.2670 | 380.1297 | 321.6239 | 199.5463 | 110.4829 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.9376 | 347.6125 | 522.3798 | (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 | | | | | | | | | | | | | |
| | 278.3522 | 246.2232 | 261.5401 | 229.6418 | 222.4353 | 200.2226 | 197.3627 | 205.2600 | 207.5930 | 231.7458 | 246.7593 | 275.2559 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.4129 | 85.0602 | 84.5729 | 83.8345 | 82.7521 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.6028 | 84.8647 | 85.4926 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 325.8900 | 289.4693 | 309.2481 | 273.9227 | 268.7973 | 249.3432 | 245.7816 | 255.6165 | 258.5218 | 277.1988 | 290.7679 | 321.9646 | (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 | 23.7460 | 19.0500 | 17.1524 | 12.5666 | 9.7068 | 7.9305 | 8.8548 | 11.5099 | 14.9502 | 19.6154 | 22.1556 | 24.4060 | (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) | | | | | | | | | | | | | |
| (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 | 2569.9796 | (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 | 3366.5218 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 191.6441 | (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 | 6214.1455 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2569.9796 | 0.2100 | 539.6957 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |

| | | | | |
|---|---|---|---|---|
| Water heating (other fuel) | 3366.5218 | 0.2100 | 706.9696 | (264) |
| Space and water heating | | | 1246.6653 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 191.6441 | 0.1443 | 27.6602 | (268) |
| Total CO2, kg/year | | | 1286.2547 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.6300 | (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 | 2569.9796 | 1.1300 | 2904.0770 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3366.5218 | 1.1300 | 3804.1696 | (278) |
| Space and water heating | | | 6708.2466 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 191.6441 | 1.5338 | 293.9502 | (282) |
| Total Primary energy kWh/year | | | 7132.2975 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 86.6700 | (287) |

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

1. Overall dwelling characteristics

| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 82.2900 (1b) | x | 2.5000 (2b) | = | 205.7250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.2900 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 205.7250 | (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 | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1458 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3958 | (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) = | 0.3365 | (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 | 0.4290 | 0.4206 | 0.4122 | 0.3701 | 0.3617 | 0.3196 | 0.3196 | 0.3112 | 0.3365 | 0.3617 | 0.3785 | 0.3953 | (22b) |
| Effective ac | 0.5920 | 0.5884 | 0.5849 | 0.5685 | 0.5654 | 0.5511 | 0.5511 | 0.5484 | 0.5566 | 0.5654 | 0.5716 | 0.5781 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 18.4700 | 1.1450 | 21.1489 | | | (27) |
| External Wall | 78.2400 | 18.4700 | 59.7700 | 0.1800 | 10.7586 | | | (29a) |
| Communal Wall | 19.7000 | 2.1000 | 17.6000 | 0.1800 | 3.1680 | | | (29a) |
| External Roof | 82.2900 | | 82.2900 | 0.1100 | 9.0519 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 180.2300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.2274 | | | (33) |
| Party Wall | | | 27.2000 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 74.9516 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 11.3400 | 0.0500 | 0.5670 |
| E3 Sill | 6.0000 | 0.0500 | 0.3000 |
| E4 Jamb | 32.3700 | 0.0500 | 1.6185 |
| E7 Party floor between dwellings (in blocks of flats) | 33.7100 | 0.0700 | 2.3597 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 5.4600 | 0.0200 | 0.1092 |
| E14 Flat roof | 7.8800 | 0.0800 | 0.6304 |
| E15 Flat roof with parapet | 31.2900 | 0.5600 | 17.5224 |
| E16 Corner (normal) | 12.5000 | 0.0900 | 1.1250 |
| E17 Corner (inverted - internal area greater than external area) | 7.5000 | -0.0900 | -0.6750 |

| | | | | |
|---|---|---|---|---|
| E18 Party wall between dwellings | 10.0000 | 0.0600 | 0.6000 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 10.8800 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 10.8800 | 0.1200 | 1.3056 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4628 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 71.6902 (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 | 40.1911 | 39.9486 | 39.7108 | 38.5941 | 38.3851 | 37.4125 | 37.4125 | 37.2324 | 37.7872 | 38.3851 | 38.8078 | 39.2497 | (38) |
| Heat transfer coeff | 111.8813 | 111.6387 | 111.4010 | 110.2842 | 110.0753 | 109.1027 | 109.1027 | 108.9225 | 109.4773 | 110.0753 | 110.4980 | 110.9399 | (39) |

Average = Sum(39)m / 12 = 110.2832

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3596 | 1.3566 | 1.3538 | 1.3402 | 1.3377 | 1.3258 | 1.3258 | 1.3236 | 1.3304 | 1.3377 | 1.3428 | 1.3482 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3402 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.5049 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 66.2183 | 65.2231 | 63.7730 | 60.9985 | 58.9510 | 56.6676 | 55.3698 | 56.8089 | 58.3864 | 60.8381 | 63.6722 | 65.9646 | (42a) |
| Hot water usage for baths | 28.5992 | 28.1745 | 27.5764 | 26.4736 | 25.6478 | 24.7321 | 24.2375 | 24.8315 | 25.4781 | 26.4579 | 27.5835 | 28.5026 | (42b) |
| Hot water usage for other uses | 40.2824 | 38.8176 | 37.3528 | 35.8880 | 34.4232 | 32.9584 | 32.9584 | 34.4232 | 35.8880 | 37.3528 | 38.8176 | 40.2824 | (42c) |

Average daily hot water use (litres/day) 124.1874 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 135.1000 | 132.2153 | 128.7022 | 123.3601 | 119.0220 | 114.3581 | 112.5656 | 116.0635 | 119.7526 | 124.6488 | 130.0733 | 134.7496 | (44) |
| Energy conte | 213.9653 | 188.2728 | 197.8105 | 168.8738 | 160.2264 | 140.6166 | 136.1384 | 143.7109 | 147.6669 | 169.1473 | 185.3133 | 210.9853 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2062.7275 | |
| Distribution loss (46)m = 0.15 x (45)m | 32.0948 | 28.2409 | 29.6716 | 25.3311 | 24.0340 | 21.0925 | 20.4208 | 21.5566 | 22.1500 | 25.3721 | 27.7970 | 31.6478 | (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 | 264.9242 | 234.3002 | 248.7694 | 218.1889 | 211.1853 | 189.9317 | 187.0973 | 194.6698 | 196.9820 | 220.1062 | 234.6283 | 261.9442 | (62) |
| WWHRS | -30.2722 | -26.7730 | -28.0351 | -23.2142 | -21.6348 | -18.5131 | -17.3530 | -18.4532 | -19.1543 | -22.5808 | -25.5814 | -29.7116 | (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 | 234.6520 | 207.5272 | 220.7343 | 194.9746 | 189.5505 | 171.4186 | 169.7443 | 176.2166 | 177.8276 | 197.5254 | 209.0470 | 232.2325 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2381.4506 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2381 | (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 | 83.8832 | 74.1076 | 78.5117 | 68.4793 | 66.0150 | 59.0838 | 58.0057 | 60.5236 | 61.4280 | 68.9812 | 73.9454 | 82.8923 | (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 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | 125.2438 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 113.0504 | 125.1629 | 113.0504 | 116.8187 | 113.0504 | 116.8187 | 113.0504 | 113.0504 | 116.8187 | 113.0504 | 116.8187 | 113.0504 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 224.1599 | 226.4860 | 220.6244 | 208.1456 | 192.3934 | 177.5886 | 167.6981 | 165.3720 | 171.2337 | 183.7124 | 199.4646 | 214.2694 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | 35.5244 | (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) | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | -100.1951 | (71) |
| Water heating gains (Table 5) | 112.7462 | 110.2791 | 105.5265 | 95.1101 | 88.7299 | 82.0608 | 77.9647 | 81.3489 | 85.3167 | 92.7167 | 102.7020 | 111.4144 | (72) |
| Total internal gains | 513.5297 | 525.5012 | 502.7744 | 483.6477 | 457.7469 | 437.0414 | 419.2864 | 420.3445 | 433.9422 | 453.0526 | 482.5585 | 502.3074 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4000 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 7.7993 | (74) |
| South | 16.0700 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 229.6088 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 237.4081 | 390.9449 | 504.3352 | 582.0649 | 618.9568 | 601.5893 | 585.2413 | 558.6136 | 530.8319 | 423.3367 | 281.7861 | 204.9050 | (83) |
| Total gains | 750.9378 | 916.4461 | 1007.1097 | 1065.7126 | 1076.7036 | 1038.6307 | 1004.5277 | 978.9581 | 964.7742 | 876.3893 | 764.3446 | 707.2124 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 15.3133 | 15.3466 | 15.3793 | 15.5350 | 15.5645 | 15.7033 | 15.7033 | 15.7292 | 15.6495 | 15.5645 | 15.5050 | 15.4432 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| alpha | 2.0209 | 2.0231 | 2.0253 | 2.0357 | 2.0376 | 2.0469 | 2.0469 | 2.0486 | 2.0433 | 2.0376 | 2.0337 | 2.0295 | |
| util living area | 0.8988 | 0.8557 | 0.8098 | 0.7425 | 0.6537 | 0.5330 | 0.4164 | 0.4390 | 0.5867 | 0.7553 | 0.8618 | 0.9083 | (86) |
| MIT | 17.7928 | 18.2744 | 18.8462 | 19.5294 | 20.1333 | 20.6062 | 20.8317 | 20.8058 | 20.4853 | 19.6914 | 18.6276 | 17.7033 | (87) |
| Th 2 | 19.7944 | 19.7967 | 19.7990 | 19.8095 | 19.8115 | 19.8207 | 19.8207 | 19.8224 | 19.8171 | 19.8115 | 19.8075 | 19.8033 | (88) |
| util rest of house | 0.8864 | 0.8390 | 0.7873 | 0.7103 | 0.6064 | 0.4622 | 0.3222 | 0.3463 | 0.5202 | 0.7183 | 0.8429 | 0.8970 | (89) |
| MIT 2 | 16.1468 | 16.7386 | 17.4409 | 18.2728 | 18.9839 | 19.5102 | 19.7245 | 19.7054 | 19.3880 | 18.4859 | 17.1932 | 16.0391 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3739 | (91) |
| MIT | 16.7623 | 17.3128 | 17.9664 | 18.7427 | 19.4137 | 19.9200 | 20.1385 | 20.1169 | 19.7983 | 18.9367 | 17.7295 | 16.6614 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.7623 | 17.3128 | 17.9664 | 18.7427 | 19.4137 | 19.9200 | 20.1385 | 20.1169 | 19.7983 | 18.9367 | 17.7295 | 16.6614 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8438 | 0.7944 | 0.7451 | 0.6767 | 0.5887 | 0.4686 | 0.3490 | 0.3709 | 0.5190 | 0.6861 | 0.7999 | 0.8558 | (94) |
| Useful gains | 633.6298 | 728.0058 | 750.3839 | 721.1984 | 633.8219 | 486.6942 | 350.5679 | 363.1256 | 500.7257 | 601.2930 | 611.3686 | 605.1994 | (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 | 1394.2974 | 1385.7519 | 1277.3660 | 1085.4903 | 849.0878 | 580.4306 | 386.0629 | 404.8528 | 623.8385 | 917.6616 | 1174.5404 | 1382.4637 | (97) |
| Space heating kWh | 565.9367 | 442.0054 | 392.0747 | 262.2902 | 160.1578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 235.3782 | 405.4837 | 578.2846 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3041.6115 | |
| 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 | 565.9367 | 442.0054 | 392.0747 | 262.2902 | 160.1578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 235.3782 | 405.4837 | 578.2846 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3041.6115 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 36.9621 | (99) |

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

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| | | |
|---|---|---|
| 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 | 565.9367 | 442.0054 | 392.0747 | 262.2902 | 160.1578 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 235.3782 | 405.4837 | 578.2846 | (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) | 612.4856 | 478.3608 | 424.3233 | 283.8638 | 173.3310 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 254.7383 | 438.8352 | 625.8492 | (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 | 234.6520 | 207.5272 | 220.7343 | 194.9746 | 189.5505 | 171.4186 | 169.7443 | 176.2166 | 177.8276 | 197.5254 | 209.0470 | 232.2325 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.1943 | 85.9587 | 85.5979 | 85.0176 | 84.0225 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.7581 | 85.7750 | 86.2532 | (217) |
| Fuel for water heating, kWh/month | 272.2360 | 241.4268 | 257.8735 | 229.3345 | 225.5950 | 213.4728 | 211.3876 | 219.4478 | 221.4541 | 233.0459 | 243.7154 | 269.2451 | (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 | 23.4896 | 18.8443 | 16.9672 | 12.4309 | 9.6020 | 7.8449 | 8.7592 | 11.3856 | 14.7887 | 19.4036 | 21.9164 | 24.1425 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -15.4974 | -23.4086 | -36.0188 | -43.4419 | -49.4683 | -47.1360 | -46.5557 | -42.6311 | -36.2046 | -28.0154 | -17.5800 | -13.2224 | (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 | -4.5841 | -9.9332 | -20.3004 | -31.3326 | -42.2761 | -42.7978 | -42.3022 | -35.4317 | -25.4660 | -14.4829 | -6.2066 | -3.6043 | (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 | 3291.7873 | (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 | 2838.2344 | (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) | 189.5748 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -677.8982 | (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 | 5727.6983 | (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 | 3291.7873 | 0.2100 | 691.2753 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2838.2344 | 0.2100 | 596.0292 | (264) |
| Space and water heating | | | 1287.3046 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 189.5748 | 0.1443 | 27.3615 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -399.1803 | 0.1332 | -53.1599 | |
| PV Unit electricity exported | -278.7179 | 0.1251 | -34.8682 | |
| Total | | | -88.0282 | (269) |
| Total CO2, kg/year | | | 1238.5672 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.0500 | (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 | 3291.7873 | 1.1300 | 3719.7196 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2838.2344 | 1.1300 | 3207.2049 | (278) |
| Space and water heating | | | 6926.9245 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 189.5748 | 1.5338 | 290.7762 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -399.1803 | 1.4921 | -595.6181 | |
| PV Unit electricity exported | -278.7179 | 0.4592 | -127.9796 | |
| Total | | | -723.5977 | (283) |
| Total Primary energy kWh/year | | | 6624.2039 | (286) |
| Target Primary Energy Rate (TPER) | | | 80.5000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F4 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F4 | **Prop Type Ref** | F4 |
| **Property** | F4 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 85 B | **DER** | 13.65 | **TER** | 13.28 |
| **Environmental** | 87 B | **% DER < TER** | | | -2.79 |
| **$CO_2$ Emissions (t/year)** | 1.33 | **DFEE** | 31.55 | **TFEE** | 41.02 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 23.08 |
| **% DPER < TPER** | -6.86 | **DPER** | 75.69 | **TPER** | 70.83 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 106.0100 | (1b) | x 2.5000 | (2b) = | 265.0250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 106.0100 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 265.0250 | (5) |

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## 2. Ventilation rate

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| | | 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) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1132 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3632 | (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) = | 0.3087 | (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 | 0.3936 | 0.3859 | 0.3782 | 0.3396 | 0.3319 | 0.2933 | 0.2933 | 0.2856 | 0.3087 | 0.3319 | 0.3473 | 0.3627 | (22b) |
| Effective ac | 0.5775 | 0.5745 | 0.5715 | 0.5577 | 0.5551 | 0.5430 | 0.5430 | 0.5408 | 0.5477 | 0.5551 | 0.5603 | 0.5658 | (25) |

---

## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 96.1800 | 19.0000 | 77.1800 | 0.1500 | 11.5770 | 9.0000 | 694.6200 | (29a) |
| Communal Wall | 6.5700 | 2.1000 | 4.4700 | 0.1500 | 0.6705 | 9.0000 | 40.2300 | (29a) |
| External Roof | 106.0100 | | 106.0100 | 0.1000 | 10.6010 | 9.0000 | 954.0900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 208.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.7042 | | | (33) |
| Party Wall | | | 28.8900 | 0.0000 | 0.0000 | 20.0000 | 577.8000 | (32) |
| Party Floor | | | 106.0100 | | | 40.0000 | 4240.4000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 7407.1400 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 69.8721 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 10.4380 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 57.1422 (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 | 50.5042 | 50.2411 | 49.9832 | 48.7720 | 48.5454 | 47.4904 | 47.4904 | 47.2951 | 47.8968 | 48.5454 | 49.0038 | 49.4831 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 107.6464 | 107.3833 | 107.1255 | 105.9142 | 105.6876 | 104.6327 | 104.6327 | 104.4373 | 105.0390 | 105.6876 | 106.1461 | 106.6253 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 105.9131 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0154 | 1.0130 | 1.0105 | 0.9991 | 0.9970 | 0.9870 | 0.9870 | 0.9852 | 0.9908 | 0.9970 | 1.0013 | 1.0058 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9991 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.7886 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 97.5920 | 96.1254 | 93.9882 | 89.8992 | 86.8816 | 83.5164 | 81.6036 | 83.7245 | 86.0495 | 89.6628 | 93.8396 | 97.2181 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30.6452 | 30.1901 | 29.5492 | 28.3675 | 27.4826 | 26.5014 | 25.9715 | 26.6079 | 27.3008 | 28.3507 | 29.5568 | 30.5416 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 43.1884 | 41.6179 | 40.0474 | 38.4769 | 36.9064 | 35.3360 | 35.3360 | 36.9064 | 38.4769 | 40.0474 | 41.6179 | 43.1884 (42c) |

Average daily hot water use (litres/day) 157.6517 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 171.4256 | 167.9334 | 163.5849 | 156.7436 | 151.2706 | 145.3538 | 142.9110 | 147.2389 | 151.8273 | 158.0609 | 165.0143 | 170.9481 | (44) |
| Energy conte | 271.4963 | 239.1349 | 251.4238 | 214.5742 | 203.6393 | 178.7294 | 172.8385 | 182.3125 | 187.2182 | 214.4871 | 235.0932 | 267.6634 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2618.6109 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 40.7244 | 35.8702 | 37.7136 | 32.1861 | 30.5459 | 26.8094 | 25.9258 | 27.3469 | 28.0827 | 32.1731 | 35.2640 | 40.1495 | (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 | | | | | | | | | | | | | |
| | 322.4552 | 285.1623 | 302.3827 | 263.8892 | 254.5983 | 228.0445 | 223.7974 | 233.2714 | 236.5333 | 265.4460 | 284.4082 | 318.6224 | (62) |
| WWHRS | -27.7604 | -24.5516 | -25.7090 | -21.2881 | -19.8397 | -16.9770 | -15.9132 | -16.9221 | -17.5650 | -20.7072 | -23.4588 | -27.2464 | (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 | | | | | | | | | | | | | |
| | 294.6948 | 260.6108 | 276.6738 | 242.6012 | 234.7586 | 211.0675 | 207.8842 | 216.3493 | 218.9683 | 244.7388 | 260.9494 | 291.3760 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2960.6725 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2961 | (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 | | | | | | | | | | | | | |
| | 103.0122 | 91.0192 | 96.3382 | 83.6747 | 80.4498 | 71.7563 | 70.2085 | 73.3586 | 74.5788 | 84.0567 | 90.4972 | 101.7378 | (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 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 136.9684 | 151.6436 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 265.6938 | 268.4509 | 261.5032 | 246.7123 | 228.0414 | 210.4935 | 198.7704 | 196.0133 | 202.9610 | 217.7519 | 236.4228 | 253.9707 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | (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) | | | | | | | | | | | | | |
| | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 138.4573 | 135.4453 | 129.4868 | 116.2148 | 108.1315 | 99.6615 | 94.3663 | 98.6003 | 103.5817 | 112.9794 | 125.6906 | 136.7444 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 608.9491 | 623.3693 | 595.7878 | 572.2906 | 540.9708 | 516.5185 | 494.9345 | 496.4115 | 512.9063 | 535.5293 | 571.4769 | 595.5130 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 853.1571 | 1025.5129 | 1114.5733 | 1171.0391 | 1177.6748 | 1135.3600 | 1096.9579 | 1071.0388 | 1058.9496 | 970.9935 | 861.3343 | 806.2869 | (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 | 19.1139 | 19.1607 | 19.2068 | 19.4265 | 19.4681 | 19.6644 | 19.6644 | 19.7012 | 19.5883 | 19.4681 | 19.3840 | 19.2969 | |
| alpha | 2.2743 | 2.2774 | 2.2805 | 2.2951 | 2.2979 | 2.3110 | 2.3110 | 2.3134 | 2.3059 | 2.2979 | 2.2923 | 2.2865 | |
| util living area | | | | | | | | | | | | | |
| | 0.8943 | 0.8489 | 0.8003 | 0.7273 | 0.6317 | 0.5033 | 0.3850 | 0.4069 | 0.5583 | 0.7387 | 0.8540 | 0.9044 | (86) |
| MIT | 18.4223 | 18.8593 | 19.3487 | 19.9211 | 20.3998 | 20.7522 | 20.9039 | 20.8874 | 20.6636 | 20.0407 | 19.1450 | 18.3426 | (87) |
| Th 2 | 20.0705 | 20.0726 | 20.0746 | 20.0841 | 20.0859 | 20.0942 | 20.0942 | 20.0957 | 20.0910 | 20.0859 | 20.0823 | 20.0785 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8838 | 0.8346 | 0.7812 | 0.7005 | 0.5933 | 0.4484 | 0.3153 | 0.3379 | 0.5058 | 0.7078 | 0.8378 | 0.8948 | (89) |
| MIT 2 | 17.7196 | 18.1437 | 18.6179 | 19.1700 | 19.6147 | 19.9282 | 20.0443 | 20.0348 | 19.8550 | 19.2940 | 18.4365 | 17.6474 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3269 | (91) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT | 17.9493 | 18.3776 | 18.8568 | 19.4155 | 19.8713 | 20.1975 | 20.3253 | 20.3135 | 20.1193 | 19.5380 | 18.6681 | 17.8747 (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 |
| adjusted MIT | 17.7993 | 18.2276 | 18.7068 | 19.2655 | 19.7213 | 20.0475 | 20.1753 | 20.1635 | 19.9693 | 19.3880 | 18.5181 | 17.7247 (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8510 | 0.8003 | 0.7485 | 0.6737 | 0.5767 | 0.4454 | 0.3218 | 0.3433 | 0.4983 | 0.6811 | 0.8041 | 0.8631 | (94) |
| Useful gains | 725.9970 | 820.7650 | 834.3126 | 788.9863 | 679.1321 | 505.6812 | 352.9737 | 367.6594 | 527.6583 | 661.3907 | 692.6240 | 695.8705 | (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 | | | | | | | | | | | | | |
| | 1453.1494 | 1431.1617 | 1307.6571 | 1097.8524 | 847.7524 | 569.9875 | 374.0912 | 393.0499 | 616.5090 | 928.7853 | 1211.9860 | 1442.0719 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 541.0014 | 410.1865 | 352.1683 | 222.3835 | 125.4535 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.9416 | 373.9406 | 555.1738 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2779.2494 | |
| 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 | | | | | | | | | | | | | |
| | 541.0014 | 410.1865 | 352.1683 | 222.3835 | 125.4535 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.9416 | 373.9406 | 555.1738 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2779.2494 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 26.2169 | (99) |

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

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| | | |
|---|---|---|
| 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 %) | 88.9000 | (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 | | | | | | | | | | | | | |
| | 541.0014 | 410.1865 | 352.1683 | 222.3835 | 125.4535 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.9416 | 373.9406 | 555.1738 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 608.5506 | 461.4022 | 396.1399 | 250.1502 | 141.1175 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223.7813 | 420.6306 | 624.4925 | (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 | | | | | | | | | | | | | |
| | 294.6948 | 260.6108 | 276.6738 | 242.6012 | 234.7586 | 211.0675 | 207.8842 | 216.3493 | 218.9683 | 244.7388 | 260.9494 | 291.3760 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.6647 | 85.3488 | 84.8995 | 84.1954 | 83.0998 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.9410 | 85.1517 | 85.7394 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 344.0094 | 305.3481 | 325.8839 | 288.1407 | 282.5021 | 262.8487 | 258.8844 | 269.4263 | 272.6878 | 291.5604 | 306.4524 | 339.8389 | (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 | 28.4593 | 22.8311 | 20.5569 | 15.0609 | 11.6334 | 9.5046 | 10.6124 | 13.7944 | 17.9176 | 23.5089 | 26.5532 | 29.2503 | (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) | | | | | | | | | | | | | |
| (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 | 3126.2648 | (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 | 3547.5830 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 229.6831 | (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 | 6989.5309 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3126.2648 | 0.2100 | 656.5156 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |

| | | | | |
|---|---|---|---|---|
| Water heating (other fuel) | 3547.5830 | 0.2100 | 744.9924 | (264) |
| Space and water heating | | | 1401.5080 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 229.6831 | 0.1443 | 33.1504 | (268) |
| Total CO2, kg/year | | | 1446.5877 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 13.6500 | (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 | 3126.2648 | 1.1300 | 3532.6792 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3547.5830 | 1.1300 | 4008.7688 | (278) |
| Space and water heating | | | 7541.4480 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 229.6831 | 1.5338 | 352.2956 | (282) |
| Total Primary energy kWh/year | | | 8023.8444 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 75.6900 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 106.0100 | (1b) | x 2.5000 | (2b) = | 265.0250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 106.0100 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 265.0250 | (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)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) = | 0.1509 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.4009 (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) = | 0.3408 (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 | 0.4345 | 0.4260 | 0.4175 | 0.3749 | 0.3663 | 0.3238 | 0.3238 | 0.3152 | 0.3408 | 0.3663 | 0.3834 | 0.4004 | (22b) |
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5703 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5581 | 0.5671 | 0.5735 | 0.5802 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 96.1800 | 19.0000 | 77.1800 | 0.1800 | 13.8924 | | | (29a) |
| Communal Wall | 6.5700 | 2.1000 | 4.4700 | 0.1800 | 0.8046 | | | (29a) |
| External Roof | 106.0100 | | 106.0100 | 0.1100 | 11.6611 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 208.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 50.2138 | | | (33) |
| Party Wall | | | 28.8900 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 69.8721 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 17.8000 | 0.0500 | 0.8900 |
| E3 Sill | 8.8500 | 0.0500 | 0.4425 |
| E4 Jamb | 51.6700 | 0.0500 | 2.5835 |
| E7 Party floor between dwellings (in blocks of flats) | 30.1800 | 0.0700 | 2.1126 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 10.9200 | 0.0200 | 0.2184 |
| E14 Flat roof | 2.6300 | 0.0800 | 0.2104 |
| E15 Flat roof with parapet | 38.4700 | 0.5600 | 21.5432 |
| E16 Corner (normal) | 10.0000 | 0.0900 | 0.9000 |
| E18 Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | | | | | | | | | | | 11.5600 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | | | | | | | | | | | 11.5600 | 0.1200 | 1.3872 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | | | | | | | 30.7378 | (36) |
| Point Thermal bridges | | | | | | | | | | | | (36a) = | 0.0000 | |
| Total fabric heat loss | | | | | | | | | | | (33) + (36) + (36a) = | | 80.9516 | (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 | 51.9850 | 51.6644 | 51.3502 | 49.8742 | 49.5981 | 48.3126 | 48.3126 | 48.0745 | 48.8077 | 49.5981 | 50.1567 | 50.7408 | (38) |
| Heat transfer coeff | 132.9366 | 132.6161 | 132.3018 | 130.8259 | 130.5497 | 129.2642 | 129.2642 | 129.0261 | 129.7593 | 130.5497 | 131.1084 | 131.6924 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 130.8245 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2540 | 1.2510 | 1.2480 | 1.2341 | 1.2315 | 1.2194 | 1.2194 | 1.2171 | 1.2240 | 1.2315 | 1.2368 | 1.2423 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2341 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.7886 | (42) |
| Hot water usage for mixer showers | 70.9760 | 69.9094 | 68.3551 | 65.3812 | 63.1866 | 60.7392 | 59.3481 | 60.8906 | 62.5815 | 65.2093 | 68.2470 | 70.7041 | (42a) |
| Hot water usage for baths | 30.6452 | 30.1901 | 29.5492 | 28.3675 | 27.4826 | 26.5014 | 25.9715 | 26.6079 | 27.3008 | 28.3507 | 29.5568 | 30.5416 | (42b) |
| Hot water usage for other uses | 43.1884 | 41.6179 | 40.0474 | 38.4769 | 36.9064 | 35.3360 | 35.3360 | 36.9064 | 38.4769 | 40.0474 | 41.6179 | 43.1884 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 133.1126 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 144.8096 | 141.7174 | 137.9517 | 132.2256 | 127.5757 | 122.5766 | 120.6555 | 124.4049 | 128.3592 | 133.6074 | 139.4217 | 144.4341 | (44) |
| Energy conte | 229.3431 | 201.8037 | 212.0266 | 181.0103 | 171.7414 | 150.7222 | 145.9223 | 154.0393 | 158.2798 | 181.3040 | 198.6318 | 226.1489 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2210.9733 | |
| Distribution loss (46)m = 0.15 x (45)m | 34.4015 | 30.2706 | 31.8040 | 27.1515 | 25.7612 | 22.6083 | 21.8883 | 23.1059 | 23.7420 | 27.1956 | 29.7948 | 33.9223 | (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 | 280.3020 | 247.8311 | 262.9855 | 230.3254 | 222.7003 | 200.0373 | 196.8812 | 204.9982 | 207.5949 | 232.2629 | 247.9468 | 277.1078 | (62) |
| WWHRS | -32.4473 | -28.6966 | -30.0495 | -24.8821 | -23.1893 | -19.8432 | -18.5998 | -19.7791 | -20.5306 | -24.2033 | -27.4194 | -31.8464 | (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 | 247.8547 | 219.1344 | 232.9361 | 205.4432 | 199.5110 | 180.1940 | 178.2814 | 185.2191 | 187.0643 | 208.0597 | 220.5275 | 245.2614 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2509.4868 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2509 | (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 | 88.9963 | 78.6066 | 83.2386 | 72.5147 | 69.8437 | 62.4439 | 61.2589 | 63.9578 | 64.9568 | 73.0233 | 78.3738 | 87.9342 | (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 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 136.9684 | 151.6436 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.6938 | 268.4509 | 261.5032 | 246.7123 | 228.0414 | 210.4935 | 198.7704 | 196.0133 | 202.9610 | 217.7519 | 236.4228 | 253.9707 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | (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) | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | (71) |
| Water heating gains (Table 5) | 119.6187 | 116.9741 | 111.8798 | 100.7148 | 93.8760 | 86.7276 | 82.3372 | 85.9648 | 90.2178 | 98.1496 | 108.8525 | 118.1912 | (72) |
| Total internal gains | 590.1104 | 604.8981 | 578.1809 | 556.7907 | 526.7153 | 503.5846 | 482.9055 | 483.7760 | 499.5423 | 520.6994 | 554.6388 | 576.9598 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 834.3185 | 1007.0417 | 1096.9663 | 1155.5391 | 1163.4193 | 1122.4261 | 1084.9289 | 1058.4033 | 1045.5857 | 956.1637 | 844.4962 | 787.7337 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 15.4776 | 15.5150 | 15.5519 | 15.7273 | 15.7606 | 15.9173 | 15.9173 | 15.9467 | 15.8566 | 15.7606 | 15.6934 | 15.6238 | |
| alpha | 2.0318 | 2.0343 | 2.0368 | 2.0485 | 2.0507 | 2.0612 | 2.0612 | 2.0631 | 2.0571 | 2.0507 | 2.0462 | 2.0416 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| util living area | | | | | | | | | | | | |
| | 0.9099 | 0.8724 | 0.8321 | 0.7703 | 0.6864 | 0.5668 | 0.4478 | 0.4708 | 0.6195 | 0.7806 | 0.8770 | 0.9183 (86) |
| MIT | 17.7130 | 18.1692 | 18.7318 | 19.4281 | 20.0564 | 20.5639 | 20.8106 | 20.7824 | 20.4360 | 19.6117 | 18.5486 | 17.6333 (87) |
| Th 2 | 19.8770 | 19.8794 | 19.8818 | 19.8928 | 19.8949 | 19.9045 | 19.9045 | 19.9063 | 19.9008 | 19.8949 | 19.8907 | 19.8863 (88) |
| util rest of house | | | | | | | | | | | | |
| | 0.8994 | 0.8582 | 0.8127 | 0.7421 | 0.6436 | 0.5004 | 0.3566 | 0.3817 | 0.5581 | 0.7482 | 0.8608 | 0.9087 (89) |
| MIT 2 | 16.0985 | 16.6631 | 17.3597 | 18.2159 | 18.9667 | 19.5438 | 19.7875 | 19.7653 | 19.4100 | 18.4549 | 17.1503 | 16.0021 (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3269 (91) |
| MIT | 16.6262 | 17.1554 | 17.8081 | 18.6122 | 19.3228 | 19.8772 | 20.1219 | 20.0978 | 19.7453 | 18.8330 | 17.6073 | 16.5353 (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 |
| adjusted MIT | 16.6262 | 17.1554 | 17.8081 | 18.6122 | 19.3228 | 19.8772 | 20.1219 | 20.0978 | 19.7453 | 18.8330 | 17.6073 | 16.5353 (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8570 | 0.8125 | 0.7677 | 0.7033 | 0.6185 | 0.4986 | 0.3759 | 0.3984 | 0.5484 | 0.7106 | 0.8165 | 0.8678 | (94) |
| Useful gains | 714.9941 | 818.1746 | 842.0925 | 812.6729 | 719.5666 | 559.6035 | 407.8169 | 421.6431 | 573.4376 | 679.4768 | 689.5326 | 683.6346 | (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 | 1638.6022 | 1625.2597 | 1496.0880 | 1270.6020 | 995.1600 | 682.1567 | 455.2598 | 477.1110 | 732.5317 | 1074.8142 | 1377.6009 | 1624.4625 | (97) |
| Space heating kWh | 687.1644 | 542.3612 | 486.5726 | 329.7090 | 205.0415 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 294.1310 | 495.4092 | 699.9760 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3740.3648 | |
| 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 | 687.1644 | 542.3612 | 486.5726 | 329.7090 | 205.0415 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 294.1310 | 495.4092 | 699.9760 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3740.3648 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.2831 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 687.1644 | 542.3612 | 486.5726 | 329.7090 | 205.0415 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 294.1310 | 495.4092 | 699.9760 | (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) | 743.6845 | 586.9710 | 526.5938 | 356.8279 | 221.9064 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 318.3236 | 536.1571 | 757.5497 | (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 | 247.8547 | 219.1344 | 232.9361 | 205.4432 | 199.5110 | 180.1940 | 178.2814 | 185.2191 | 187.0643 | 208.0597 | 220.5275 | 245.2614 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.4458 | 86.2421 | 85.9209 | 85.3892 | 84.4401 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.1230 | 86.0609 | 86.4964 | (217) |
| Fuel for water heating, kWh/month | 286.7168 | 254.0923 | 271.1052 | 240.5961 | 236.2751 | 224.4011 | 222.0192 | 230.6589 | 232.9568 | 244.4224 | 256.2458 | 283.5511 | (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 | 28.4593 | 22.8311 | 20.5569 | 15.0609 | 11.6334 | 9.5046 | 10.6124 | 13.7944 | 17.9176 | 23.5089 | 26.5532 | 29.2503 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -19.7148 | -29.6413 | -45.3953 | -54.4772 | -61.7796 | -58.7598 | -58.0236 | -53.2497 | -45.4031 | -35.3499 | -22.3134 | -16.8349 | (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 | -6.1551 | -13.3112 | -27.1578 | -41.8511 | -56.4100 | -57.0973 | -56.4476 | -47.3146 | -34.0441 | -19.3986 | -8.3297 | -4.8421 | (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 | | | | | | | | | | | | 4048.0139 | (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 | | | | | | | | | | | | 2983.0407 | (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) | | | | | | | | | | | | 229.6831 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -873.3016 | (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 | | | | | | | | | | | | 6473.4361 | (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 | 4048.0139 | 0.2100 | 850.0829 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2983.0407 | 0.2100 | 626.4386 | (264) |
| Space and water heating | | | 1476.5215 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 229.6831 | 0.1443 | 33.1504 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -500.9426 | 0.1333 | -66.7627 | |
| PV Unit electricity exported | -372.3591 | 0.1251 | -46.5975 | |
| Total | | | -113.3601 | (269) |
| Total CO2, kg/year | | | 1408.2410 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 13.2800 | (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 | 4048.0139 | 1.1300 | 4574.2557 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2983.0407 | 1.1300 | 3370.8360 | (278) |
| Space and water heating | | | 7945.0918 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 229.6831 | 1.5338 | 352.2956 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -500.9426 | 1.4925 | -747.6487 | |
| PV Unit electricity exported | -372.3591 | 0.4593 | -171.0307 | |
| Total | | | -918.6794 | (283) |
| Total Primary energy kWh/year | | | 7508.8088 | (286) |
| Target Primary Energy Rate (TPER) | | | 70.8300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F4 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F4 | **Prop Type Ref** | F4 |
| **Property** | F4 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 85 B | **DER** | 13.65 | **TER** | 13.28 |
| **Environmental** | 87 B | **% DER < TER** | | | -2.79 |
| **$CO_2$ Emissions (t/year)** | 1.33 | **DFEE** | 31.55 | **TFEE** | 41.02 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 23.08 |
| **% DPER < TPER** | -6.86 | **DPER** | 75.69 | **TPER** | 70.83 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 106.0100 | (1b) | x 2.5000 | (2b) = | 265.0250 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 106.0100 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 265.0250 | (5) |

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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) = | 0.1509 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.4009 (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) = | 0.3408 (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 | 0.4345 | 0.4260 | 0.4175 | 0.3749 | 0.3663 | 0.3238 | 0.3238 | 0.3152 | 0.3408 | 0.3663 | 0.3834 | 0.4004 | (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.0000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 0.0000 | (23c) |
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5703 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5581 | 0.5671 | 0.5735 | 0.5802 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 96.1800 | 19.0000 | 77.1800 | 0.1500 | 11.5770 | 9.0000 | 694.6200 | (29a) |
| Communal Wall | 6.5700 | 2.1000 | 4.4700 | 0.1500 | 0.6705 | 9.0000 | 40.2300 | (29a) |
| External Roof | 106.0100 | | 106.0100 | 0.1000 | 10.6010 | 9.0000 | 954.0900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 208.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.7042 | | | (33) |
| Party Wall | | | 28.8900 | 0.0000 | 0.0000 | 20.0000 | 577.8000 | (32) |
| Party Floor | | | 106.0100 | | | 40.0000 | 4240.4000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 7407.1400 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 69.8721 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 10.4380 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 57.1422 (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 | 51.9850 | 51.6644 | 51.3502 | 49.8742 | 49.5981 | 48.3126 | 48.3126 | 48.0745 | 48.8077 | 49.5981 | 50.1567 | 50.7408 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 109.1272 | 108.8067 | 108.4924 | 107.0165 | 106.7403 | 105.4548 | 105.4548 | 105.2167 | 105.9499 | 106.7403 | 107.2990 | 107.8830 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 107.0151 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0294 | 1.0264 | 1.0234 | 1.0095 | 1.0069 | 0.9948 | 0.9948 | 0.9925 | 0.9994 | 1.0069 | 1.0122 | 1.0177 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0095 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.7886 | (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 | | | | | | | | | | | | | |
| | 30.6452 | 30.1901 | 29.5492 | 28.3675 | 27.4826 | 26.5014 | 25.9715 | 26.6079 | 27.3008 | 28.3507 | 29.5568 | 30.5416 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 43.1884 | 41.6179 | 40.0474 | 38.4769 | 36.9064 | 35.3360 | 35.3360 | 36.9064 | 38.4769 | 40.0474 | 41.6179 | 43.1884 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 67.6751 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 73.8336 | 71.8080 | 69.5966 | 66.8444 | 64.3891 | 61.8374 | 61.3074 | 63.5143 | 65.7778 | 68.3981 | 71.1747 | 73.7300 | (44) |
| Energy conte | 116.9344 | 102.2536 | 106.9674 | 91.5066 | 86.6800 | 76.0363 | 74.1460 | 78.6440 | 81.1106 | 92.8156 | 101.4014 | 115.4434 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1123.9395 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 99.3942 | 86.9156 | 90.9223 | 77.7806 | 73.6780 | 64.6308 | 63.0241 | 66.8474 | 68.9440 | 78.8933 | 86.1912 | 98.1269 | (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 | | | | | | | | | | | | | |
| | 99.3942 | 86.9156 | 90.9223 | 77.7806 | 73.6780 | 64.6308 | 63.0241 | 66.8474 | 68.9440 | 78.8933 | 86.1912 | 98.1269 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 955.3485 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 955 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 56.8400 | 50.6449 | 55.3023 | 52.7743 | 53.7646 | 51.2862 | 52.9957 | 53.7646 | 52.7743 | 55.3023 | 54.2624 | 56.8400 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 646.5512 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 39.0586 | 34.3901 | 36.5561 | 32.6387 | 31.8606 | 28.9793 | 29.0050 | 30.1530 | 30.4296 | 33.5489 | 35.1134 | 38.7417 | (65) |

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

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| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 136.9684 | 151.6436 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 265.6938 | 268.4509 | 261.5032 | 246.7123 | 228.0414 | 210.4935 | 198.7704 | 196.0133 | 202.9610 | 217.7519 | 236.4228 | 253.9707 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | (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) | | | | | | | | | | | | | |
| | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 52.4981 | 51.1758 | 49.1346 | 45.3316 | 42.8235 | 40.2490 | 38.9852 | 40.5282 | 42.2633 | 45.0926 | 48.7686 | 52.0722 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 519.9898 | 536.0998 | 512.4357 | 498.4074 | 472.6628 | 457.1060 | 439.5534 | 438.3394 | 451.5878 | 464.6424 | 491.5549 | 507.8408 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 764.1978 | 938.2434 | 1031.2211 | 1097.1558 | 1109.3668 | 1075.9475 | 1041.5768 | 1012.9667 | 997.6312 | 900.1066 | 781.4123 | 718.6147 | (84) |

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7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 18.8545 | 18.9100 | 18.9648 | 19.2264 | 19.2761 | 19.5111 | 19.5111 | 19.5552 | 19.4199 | 19.2761 | 19.1758 | 19.0719 | |
| alpha | 2.2570 | 2.2607 | 2.2643 | 2.2818 | 2.2851 | 2.3007 | 2.3007 | 2.3037 | 2.2947 | 2.2851 | 2.2784 | 2.2715 | |
| util living area | | | | | | | | | | | | | |
| | 0.9132 | 0.8698 | 0.8230 | 0.7506 | 0.6561 | 0.5255 | 0.4042 | 0.4279 | 0.5831 | 0.7647 | 0.8759 | 0.9224 | (86) |
| MIT | 18.2159 | 18.6803 | 19.2017 | 19.8225 | 20.3377 | 20.7246 | 20.8918 | 20.8729 | 20.6253 | 19.9451 | 18.9866 | 18.1390 | (87) |
| Th 2 | 20.0589 | 20.0614 | 20.0639 | 20.0754 | 20.0776 | 20.0877 | 20.0877 | 20.0896 | 20.0838 | 20.0776 | 20.0732 | 20.0686 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9041 | 0.8568 | 0.8052 | 0.7247 | 0.6179 | 0.4693 | 0.3316 | 0.3562 | 0.5299 | 0.7351 | 0.8614 | 0.9142 | (89) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT 2 | 17.5118 | 17.9648 | 18.4721 | 19.0741 | 19.5554 | 19.9023 | 20.0313 | 20.0205 | 19.8196 | 19.2024 | 18.2797 | 17.4430 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3269 | (91) |
| MIT | 17.7419 | 18.1986 | 18.7106 | 19.3187 | 19.8111 | 20.1711 | 20.3126 | 20.2991 | 20.0829 | 19.4452 | 18.5107 | 17.6705 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.7419 | 18.1986 | 18.7106 | 19.3187 | 19.8111 | 20.1711 | 20.3126 | 20.2991 | 20.0829 | 19.4452 | 18.5107 | 17.6705 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8751 | 0.8255 | 0.7750 | 0.7009 | 0.6059 | 0.4747 | 0.3502 | 0.3734 | 0.5299 | 0.7120 | 0.8312 | 0.8866 | (94) |
| Useful gains | 668.7575 | 774.4851 | 799.2146 | 768.9582 | 672.1294 | 510.8009 | 364.7282 | 378.2064 | 528.6283 | 640.8984 | 649.5404 | 637.1039 | (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 | | | | | | | | | | | | | |
| | 1466.8827 | 1446.9812 | 1324.7581 | 1114.9702 | 865.7840 | 587.4974 | 391.5106 | 410.2518 | 633.8907 | 944.1341 | 1224.3592 | 1453.2384 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 593.8051 | 451.9174 | 391.0044 | 249.1286 | 144.0790 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 225.6074 | 413.8695 | 607.2040 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3076.6155 | |
| 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 | | | | | | | | | | | | | |
| | 593.8051 | 451.9174 | 391.0044 | 249.1286 | 144.0790 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 225.6074 | 413.8695 | 607.2040 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3076.6155 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 29.0219 | (99) |

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8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 991.2750 | 780.3654 | 799.6471 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7604 | 0.8204 | 0.8069 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 753.8127 | 640.2387 | 645.2305 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1200.0169 | 1162.5635 | 1131.8528 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 321.2670 | 388.6096 | 362.0470 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 80.3167 | 97.1524 | 90.5118 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 267.9809 | (107) |
| Energy for space heating | | | | | | | | | | | | 29.0219 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.5279 | (108) |
| Total | | | | | | | | | | | | 31.5498 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 31.5 | (109) |

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

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1. Overall dwelling characteristics

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| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 106.0100 | (1b) | x 2.5000 | (2b) = | 265.0250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 106.0100 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 265.0250 | (5) |

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2. Ventilation rate

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| | | 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) = | 0.1509 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4009 | (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) = | 0.3408 | (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 | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.4345 | 0.4260 | 0.4175 | 0.3749 | 0.3663 | 0.3238 | 0.3238 | 0.3152 | 0.3408 | 0.3663 | 0.3834 | 0.4004 | (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.0000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 0.0000 | (23c) |
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5703 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5581 | 0.5671 | 0.5735 | 0.5802 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 96.1800 | 19.0000 | 77.1800 | 0.1800 | 13.8924 | | | (29a) |
| Communal Wall | 6.5700 | 2.1000 | 4.4700 | 0.1800 | 0.8046 | | | (29a) |
| External Roof | 106.0100 | | 106.0100 | 0.1100 | 11.6611 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 208.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 50.2138 | | | (33) |
| Party Wall | | | 28.8900 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 69.8721 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 17.8000 | 0.0500 | 0.8900 |
| E3 | Sill | 8.8500 | 0.0500 | 0.4425 |
| E4 | Jamb | 51.6700 | 0.0500 | 2.5835 |
| E7 | Party floor between dwellings (in blocks of flats) | 30.1800 | 0.0700 | 2.1126 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 10.9200 | 0.0200 | 0.2184 |
| E14 | Flat roof | 2.6300 | 0.0800 | 0.2104 |
| E15 | Flat roof with parapet | 38.4700 | 0.5600 | 21.5432 |
| E16 | Corner (normal) | 10.0000 | 0.0900 | 0.9000 |
| E18 | Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 |
| P3 | Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.5600 | 0.0000 | 0.0000 |
| P4 | Party wall - Roof (insulation at ceiling level) | 11.5600 | 0.1200 | 1.3872 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.7378 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 80.9516 (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 | 51.9850 | 51.6644 | 51.3502 | 49.8742 | 49.5981 | 48.3126 | 48.3126 | 48.0745 | 48.8077 | 49.5981 | 50.1567 | 50.7408 | (38) |
| Heat transfer coeff | 132.9366 | 132.6161 | 132.3018 | 130.8259 | 130.5497 | 129.2642 | 129.2642 | 129.0261 | 129.7593 | 130.5497 | 131.1084 | 131.6924 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 130.8245 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2540 | 1.2510 | 1.2480 | 1.2341 | 1.2315 | 1.2194 | 1.2194 | 1.2171 | 1.2240 | 1.2315 | 1.2368 | 1.2423 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2341 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.7886 (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.6452 | 30.1901 | 29.5492 | 28.3675 | 27.4826 | 26.5014 | 25.9715 | 26.6079 | 27.3008 | 28.3507 | 29.5568 | 30.5416 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 43.1884 | 41.6179 | 40.0474 | 38.4769 | 36.9064 | 35.3360 | 35.3360 | 36.9064 | 38.4769 | 40.0474 | 41.6179 | 43.1884 | (42c) |

Average daily hot water use (litres/day) 67.6751 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 73.8336 | 71.8080 | 69.5966 | 66.8444 | 64.3891 | 61.8374 | 61.3074 | 63.5143 | 65.7778 | 68.3981 | 71.1747 | 73.7300 | (44) |
| Energy conte | 116.9344 | 102.2536 | 106.9674 | 91.5066 | 86.6800 | 76.0363 | 74.1460 | 78.6440 | 81.1106 | 92.8156 | 101.4014 | 115.4434 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1123.9395 | |
| Distribution loss (46)m = 0.15 x (45)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 99.3942 | 86.9156 | 90.9223 | 77.7806 | 73.6780 | 64.6308 | 63.0241 | 66.8474 | 68.9440 | 78.8933 | 86.1912 | 98.1269 | (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 | 99.3942 | 86.9156 | 90.9223 | 77.7806 | 73.6780 | 64.6308 | 63.0241 | 66.8474 | 68.9440 | 78.8933 | 86.1912 | 98.1269 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 955.3485 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 955 | (64) |
| Electric shower(s) | 56.8400 | 50.6449 | 55.3023 | 52.7743 | 53.7646 | 51.2862 | 52.9957 | 53.7646 | 52.7743 | 55.3023 | 54.2624 | 56.8400 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 646.5512 | (64a) |
| Heat gains from water heating, kWh/month | 39.0586 | 34.3901 | 36.5561 | 32.6387 | 31.8606 | 28.9793 | 29.0050 | 30.1530 | 30.4296 | 33.5489 | 35.1134 | 38.7417 | (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 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 136.9684 | 151.6436 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.6938 | 268.4509 | 261.5032 | 246.7123 | 228.0414 | 210.4935 | 198.7704 | 196.0133 | 202.9610 | 217.7519 | 236.4228 | 253.9707 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | (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) | | | | | | | | | | | | | |
| | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 52.4981 | 51.1758 | 49.1346 | 45.3316 | 42.8235 | 40.2490 | 38.9852 | 40.5282 | 42.2633 | 45.0926 | 48.7686 | 52.0722 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 519.9898 | 536.0998 | 512.4357 | 498.4074 | 472.6628 | 457.1060 | 439.5534 | 438.3394 | 451.5878 | 464.6424 | 491.5549 | 507.8408 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 764.1978 | 938.2434 | 1031.2211 | 1097.1558 | 1109.3668 | 1075.9475 | 1041.5768 | 1012.9667 | 997.6312 | 900.1066 | 781.4123 | 718.6147 | (84) |

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## 7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 15.4776 | 15.5150 | 15.5519 | 15.7273 | 15.7606 | 15.9173 | 15.9173 | 15.9467 | 15.8566 | 15.7606 | 15.6934 | 15.6238 | |
| alpha | 2.0318 | 2.0343 | 2.0368 | 2.0485 | 2.0507 | 2.0612 | 2.0612 | 2.0631 | 2.0571 | 2.0507 | 2.0462 | 2.0416 | |
| util living area | | | | | | | | | | | | | |
| | 0.9218 | 0.8853 | 0.8460 | 0.7848 | 0.7020 | 0.5818 | 0.4616 | 0.4860 | 0.6359 | 0.7970 | 0.8907 | 0.9297 | (86) |
| MIT | 17.5899 | 18.0612 | 18.6408 | 19.3621 | 20.0114 | 20.5407 | 20.7992 | 20.7687 | 20.4055 | 19.5458 | 18.4475 | 17.5084 | (87) |
| Th 2 | 19.8770 | 19.8794 | 19.8818 | 19.8928 | 19.8949 | 19.9045 | 19.9045 | 19.9063 | 19.9008 | 19.8949 | 19.8907 | 19.8863 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9125 | 0.8722 | 0.8278 | 0.7576 | 0.6599 | 0.5152 | 0.3689 | 0.3954 | 0.5748 | 0.7660 | 0.8760 | 0.9213 | (89) |
| MIT 2 | 16.7868 | 17.2476 | 17.8138 | 18.5158 | 19.1279 | 19.6048 | 19.8065 | 19.7879 | 19.4924 | 18.7049 | 17.6417 | 16.7126 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3269 | (91) |
| MIT | 17.0493 | 17.5136 | 18.0841 | 18.7925 | 19.4167 | 19.9107 | 20.1310 | 20.1085 | 19.7908 | 18.9797 | 17.9051 | 16.9727 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.0493 | 17.5136 | 18.0841 | 18.7925 | 19.4167 | 19.9107 | 20.1310 | 20.1085 | 19.7908 | 18.9797 | 17.9051 | 16.9727 | (93) |

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## 8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8805 | 0.8362 | 0.7914 | 0.7256 | 0.6393 | 0.5156 | 0.3894 | 0.4134 | 0.5680 | 0.7351 | 0.8414 | 0.8909 | (94) |
| Useful gains | 672.8585 | 784.5996 | 816.1201 | 796.1108 | 709.2292 | 554.7941 | 405.5420 | 418.7549 | 566.6270 | 661.6922 | 657.4565 | 640.1979 | (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 | | | | | | | | | | | | | |
| | 1694.8474 | 1672.7605 | 1532.5988 | 1294.1886 | 1007.4100 | 686.4812 | 456.4303 | 478.4872 | 738.4400 | 1093.9735 | 1416.6338 | 1682.0726 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 760.3597 | 596.8442 | 533.0602 | 358.6160 | 221.8465 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 321.6173 | 546.6076 | 775.1548 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4114.1062 | |
| 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 | | | | | | | | | | | | | |
| | 760.3597 | 596.8442 | 533.0602 | 358.6160 | 221.8465 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 321.6173 | 546.6076 | 775.1548 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4114.1062 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 38.8087 | (99) |

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## 8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1215.0833 | 956.5550 | 980.5986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.6691 | 0.7363 | 0.7205 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 813.0319 | 704.3322 | 706.4740 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1200.0169 | 1162.5635 | 1131.8528 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 278.6292 | 340.9241 | 316.4818 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.6573 | 85.2310 | 79.1205 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 234.0088 | (107) |
| Energy for space heating | | | | | | | | | | | | 38.8087 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.2074 | (108) |
| Total | | | | | | | | | | | | 41.0161 | (109) |
| Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 41.0 | (109) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F4 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F4 | **Prop Type Ref** | F4 |
| **Property** | F4 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 85 B | **DER** | 13.65 | **TER** | 13.28 |
| **Environmental** | 87 B | **% DER < TER** | | | -2.79 |
| **$CO_2$ Emissions (t/year)** | 1.33 | **DFEE** | 31.55 | **TFEE** | 41.02 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 23.08 |
| **% DPER < TPER** | -6.86 | **DPER** | 75.69 | **TPER** | 70.83 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 106.0100 | (1b) | x 2.5000 | (2b) = | 265.0250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 106.0100 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 265.0250 | (5) |

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## 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) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1132 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3632 | (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) = | 0.3087 | (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 | 0.3936 | 0.3859 | 0.3782 | 0.3396 | 0.3319 | 0.2933 | 0.2933 | 0.2856 | 0.3087 | 0.3319 | 0.3473 | 0.3627 | (22b) |
| Effective ac | 0.5775 | 0.5745 | 0.5715 | 0.5577 | 0.5551 | 0.5430 | 0.5430 | 0.5408 | 0.5477 | 0.5551 | 0.5603 | 0.5658 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 96.1800 | 19.0000 | 77.1800 | 0.1500 | 11.5770 | 9.0000 | 694.6200 | (29a) |
| Communal Wall | 6.5700 | 2.1000 | 4.4700 | 0.1500 | 0.6705 | 9.0000 | 40.2300 | (29a) |
| External Roof | 106.0100 | | 106.0100 | 0.1000 | 10.6010 | 9.0000 | 954.0900 | (30) |
| Total net area of external elements Aum(A, m2) | | | 208.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.7042 | | | (33) |
| Party Wall | | | 28.8900 | 0.0000 | 0.0000 | 20.0000 | 577.8000 | (32) |
| Party Floor | | | 106.0100 | | | 40.0000 | 4240.4000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 7407.1400 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 69.8721 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 10.4380 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 57.1422 (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 | 50.5042 | 50.2411 | 49.9832 | 48.7720 | 48.5454 | 47.4904 | 47.4904 | 47.2951 | 47.8968 | 48.5454 | 49.0038 | 49.4831 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 107.6464 | 107.3833 | 107.1255 | 105.9142 | 105.6876 | 104.6327 | 104.6327 | 104.4373 | 105.0390 | 105.6876 | 106.1461 | 106.6253 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 105.9131 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0154 | 1.0130 | 1.0105 | 0.9991 | 0.9970 | 0.9870 | 0.9870 | 0.9852 | 0.9908 | 0.9970 | 1.0013 | 1.0058 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9991 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.7886 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 97.5920 | 96.1254 | 93.9882 | 89.8992 | 86.8816 | 83.5164 | 81.6036 | 83.7245 | 86.0495 | 89.6628 | 93.8396 | 97.2181 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30.6452 | 30.1901 | 29.5492 | 28.3675 | 27.4826 | 26.5014 | 25.9715 | 26.6079 | 27.3008 | 28.3507 | 29.5568 | 30.5416 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 43.1884 | 41.6179 | 40.0474 | 38.4769 | 36.9064 | 35.3360 | 35.3360 | 36.9064 | 38.4769 | 40.0474 | 41.6179 | 43.1884 (42c) |

Average daily hot water use (litres/day) 157.6517 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 171.4256 | 167.9334 | 163.5849 | 156.7436 | 151.2706 | 145.3538 | 142.9110 | 147.2389 | 151.8273 | 158.0609 | 165.0143 | 170.9481 | (44) |
| Energy conte | 271.4963 | 239.1349 | 251.4238 | 214.5742 | 203.6393 | 178.7294 | 172.8385 | 182.3125 | 187.2182 | 214.4871 | 235.0932 | 267.6634 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2618.6109 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 40.7244 | 35.8702 | 37.7136 | 32.1861 | 30.5459 | 26.8094 | 25.9258 | 27.3469 | 28.0827 | 32.1731 | 35.2640 | 40.1495 | (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 | | | | | | | | | | | | | |
| | 322.4552 | 285.1623 | 302.3827 | 263.8892 | 254.5983 | 228.0445 | 223.7974 | 233.2714 | 236.5333 | 265.4460 | 284.4082 | 318.6224 | (62) |
| WWHRS | -27.7604 | -24.5516 | -25.7090 | -21.2881 | -19.8397 | -16.9770 | -15.9132 | -16.9221 | -17.5650 | -20.7072 | -23.4588 | -27.2464 | (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 | | | | | | | | | | | | | |
| | 294.6948 | 260.6108 | 276.6738 | 242.6012 | 234.7586 | 211.0675 | 207.8842 | 216.3493 | 218.9683 | 244.7388 | 260.9494 | 291.3760 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2960.6725 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2961 | (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 | | | | | | | | | | | | | |
| | 103.0122 | 91.0192 | 96.3382 | 83.6747 | 80.4498 | 71.7563 | 70.2085 | 73.3586 | 74.5788 | 84.0567 | 90.4972 | 101.7378 | (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 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 136.9684 | 151.6436 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 265.6938 | 268.4509 | 261.5032 | 246.7123 | 228.0414 | 210.4935 | 198.7704 | 196.0133 | 202.9610 | 217.7519 | 236.4228 | 253.9707 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | (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) | | | | | | | | | | | | | |
| | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 138.4573 | 135.4453 | 129.4868 | 116.2148 | 108.1315 | 99.6615 | 94.3663 | 98.6003 | 103.5817 | 112.9794 | 125.6906 | 136.7444 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 608.9491 | 623.3693 | 595.7878 | 572.2906 | 540.9708 | 516.5185 | 494.9345 | 496.4115 | 512.9063 | 535.5293 | 571.4769 | 595.5130 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 853.1571 | 1025.5129 | 1114.5733 | 1171.0391 | 1177.6748 | 1135.3600 | 1096.9579 | 1071.0388 | 1058.9496 | 970.9935 | 861.3343 | 806.2869 | (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 | 19.1139 | 19.1607 | 19.2068 | 19.4265 | 19.4681 | 19.6644 | 19.6644 | 19.7012 | 19.5883 | 19.4681 | 19.3840 | 19.2969 | |
| alpha | 2.2743 | 2.2774 | 2.2805 | 2.2951 | 2.2979 | 2.3110 | 2.3110 | 2.3134 | 2.3059 | 2.2979 | 2.2923 | 2.2865 | |
| util living area | | | | | | | | | | | | | |
| | 0.8943 | 0.8489 | 0.8003 | 0.7273 | 0.6317 | 0.5033 | 0.3850 | 0.4069 | 0.5583 | 0.7387 | 0.8540 | 0.9044 | (86) |
| MIT | 18.4223 | 18.8593 | 19.3487 | 19.9211 | 20.3998 | 20.7522 | 20.9039 | 20.8874 | 20.6636 | 20.0407 | 19.1450 | 18.3426 | (87) |
| Th 2 | 20.0705 | 20.0726 | 20.0746 | 20.0841 | 20.0859 | 20.0942 | 20.0942 | 20.0957 | 20.0910 | 20.0859 | 20.0823 | 20.0785 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8838 | 0.8346 | 0.7812 | 0.7005 | 0.5933 | 0.4484 | 0.3153 | 0.3379 | 0.5058 | 0.7078 | 0.8378 | 0.8948 | (89) |
| MIT 2 | 17.7196 | 18.1437 | 18.6179 | 19.1700 | 19.6147 | 19.9282 | 20.0443 | 20.0348 | 19.8550 | 19.2940 | 18.4365 | 17.6474 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3269 | (91) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT | 17.9493 | 18.3776 | 18.8568 | 19.4155 | 19.8713 | 20.1975 | 20.3253 | 20.3135 | 20.1193 | 19.5380 | 18.6681 | 17.8747 (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 |
| adjusted MIT | 17.7993 | 18.2276 | 18.7068 | 19.2655 | 19.7213 | 20.0475 | 20.1753 | 20.1635 | 19.9693 | 19.3880 | 18.5181 | 17.7247 (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8510 | 0.8003 | 0.7485 | 0.6737 | 0.5767 | 0.4454 | 0.3218 | 0.3433 | 0.4983 | 0.6811 | 0.8041 | 0.8631 | (94) |
| Useful gains | 725.9970 | 820.7650 | 834.3126 | 788.9863 | 679.1321 | 505.6812 | 352.9737 | 367.6594 | 527.6583 | 661.3907 | 692.6240 | 695.8705 | (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 | | | | | | | | | | | | | |
| | 1453.1494 | 1431.1617 | 1307.6571 | 1097.8524 | 847.7524 | 569.9875 | 374.0912 | 393.0499 | 616.5090 | 928.7853 | 1211.9860 | 1442.0719 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 541.0014 | 410.1865 | 352.1683 | 222.3835 | 125.4535 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.9416 | 373.9406 | 555.1738 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2779.2494 | |
| 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 | | | | | | | | | | | | | |
| | 541.0014 | 410.1865 | 352.1683 | 222.3835 | 125.4535 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.9416 | 373.9406 | 555.1738 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2779.2494 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 26.2169 | (99) |

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

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| | | |
|---|---|---|
| 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 %) | 88.9000 | (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 | | | | | | | | | | | | | |
| | 541.0014 | 410.1865 | 352.1683 | 222.3835 | 125.4535 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.9416 | 373.9406 | 555.1738 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 608.5506 | 461.4022 | 396.1399 | 250.1502 | 141.1175 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223.7813 | 420.6306 | 624.4925 | (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 | | | | | | | | | | | | | |
| | 294.6948 | 260.6108 | 276.6738 | 242.6012 | 234.7586 | 211.0675 | 207.8842 | 216.3493 | 218.9683 | 244.7388 | 260.9494 | 291.3760 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.6647 | 85.3488 | 84.8995 | 84.1954 | 83.0998 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.9410 | 85.1517 | 85.7394 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 344.0094 | 305.3481 | 325.8839 | 288.1407 | 282.5021 | 262.8487 | 258.8844 | 269.4263 | 272.6878 | 291.5604 | 306.4524 | 339.8389 | (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 | 28.4593 | 22.8311 | 20.5569 | 15.0609 | 11.6334 | 9.5046 | 10.6124 | 13.7944 | 17.9176 | 23.5089 | 26.5532 | 29.2503 | (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) | | | | | | | | | | | | | |
| (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 | 3126.2648 | (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 | 3547.5830 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 229.6831 | (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 | 6989.5309 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3126.2648 | 0.2100 | 656.5156 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |

| | | | | |
|---|---|---|---|---|
| Water heating (other fuel) | 3547.5830 | 0.2100 | 744.9924 | (264) |
| Space and water heating | | | 1401.5080 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 229.6831 | 0.1443 | 33.1504 | (268) |
| Total CO2, kg/year | | | 1446.5877 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 13.6500 | (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 | 3126.2648 | 1.1300 | 3532.6792 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3547.5830 | 1.1300 | 4008.7688 | (278) |
| Space and water heating | | | 7541.4480 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 229.6831 | 1.5338 | 352.2956 | (282) |
| Total Primary energy kWh/year | | | 8023.8444 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 75.6900 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 106.0100 | (1b) | x 2.5000 | (2b) = | 265.0250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 106.0100 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 265.0250 | (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)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) = | 0.1509 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.4009 (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) = | 0.3408 (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 | 0.4345 | 0.4260 | 0.4175 | 0.3749 | 0.3663 | 0.3238 | 0.3238 | 0.3152 | 0.3408 | 0.3663 | 0.3834 | 0.4004 | (22b) |
| Effective ac | 0.5944 | 0.5907 | 0.5871 | 0.5703 | 0.5671 | 0.5524 | 0.5524 | 0.5497 | 0.5581 | 0.5671 | 0.5735 | 0.5802 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 19.0000 | 1.1450 | 21.7557 | | | (27) |
| External Wall | 96.1800 | 19.0000 | 77.1800 | 0.1800 | 13.8924 | | | (29a) |
| Communal Wall | 6.5700 | 2.1000 | 4.4700 | 0.1800 | 0.8046 | | | (29a) |
| External Roof | 106.0100 | | 106.0100 | 0.1100 | 11.6611 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 208.7600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 50.2138 | | | (33) |
| Party Wall | | | 28.8900 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 69.8721 (35)

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 17.8000 | 0.0500 | 0.8900 |
| E3 Sill | 8.8500 | 0.0500 | 0.4425 |
| E4 Jamb | 51.6700 | 0.0500 | 2.5835 |
| E7 Party floor between dwellings (in blocks of flats) | 30.1800 | 0.0700 | 2.1126 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 10.9200 | 0.0200 | 0.2184 |
| E14 Flat roof | 2.6300 | 0.0800 | 0.2104 |
| E15 Flat roof with parapet | 38.4700 | 0.5600 | 21.5432 |
| E16 Corner (normal) | 10.0000 | 0.0900 | 0.9000 |
| E18 Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | | | | | | | | | | | 11.5600 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | | | | | | | | | | | 11.5600 | 0.1200 | 1.3872 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | | | | | | | 30.7378 | (36) |
| Point Thermal bridges | | | | | | | | | | | | (36a) = | 0.0000 | |
| Total fabric heat loss | | | | | | | | | | | (33) + (36) + (36a) = | | 80.9516 | (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 | 51.9850 | 51.6644 | 51.3502 | 49.8742 | 49.5981 | 48.3126 | 48.3126 | 48.0745 | 48.8077 | 49.5981 | 50.1567 | 50.7408 | (38) |
| Heat transfer coeff | 132.9366 | 132.6161 | 132.3018 | 130.8259 | 130.5497 | 129.2642 | 129.2642 | 129.0261 | 129.7593 | 130.5497 | 131.1084 | 131.6924 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 130.8245 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2540 | 1.2510 | 1.2480 | 1.2341 | 1.2315 | 1.2194 | 1.2194 | 1.2171 | 1.2240 | 1.2315 | 1.2368 | 1.2423 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2341 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.7886 | (42) |
| Hot water usage for mixer showers | 70.9760 | 69.9094 | 68.3551 | 65.3812 | 63.1866 | 60.7392 | 59.3481 | 60.8906 | 62.5815 | 65.2093 | 68.2470 | 70.7041 | (42a) |
| Hot water usage for baths | 30.6452 | 30.1901 | 29.5492 | 28.3675 | 27.4826 | 26.5014 | 25.9715 | 26.6079 | 27.3008 | 28.3507 | 29.5568 | 30.5416 | (42b) |
| Hot water usage for other uses | 43.1884 | 41.6179 | 40.0474 | 38.4769 | 36.9064 | 35.3360 | 35.3360 | 36.9064 | 38.4769 | 40.0474 | 41.6179 | 43.1884 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 133.1126 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 144.8096 | 141.7174 | 137.9517 | 132.2256 | 127.5757 | 122.5766 | 120.6555 | 124.4049 | 128.3592 | 133.6074 | 139.4217 | 144.4341 | (44) |
| Energy conte | 229.3431 | 201.8037 | 212.0266 | 181.0103 | 171.7414 | 150.7222 | 145.9223 | 154.0393 | 158.2798 | 181.3040 | 198.6318 | 226.1489 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2210.9733 | |
| Distribution loss (46)m = 0.15 x (45)m | 34.4015 | 30.2706 | 31.8040 | 27.1515 | 25.7612 | 22.6083 | 21.8883 | 23.1059 | 23.7420 | 27.1956 | 29.7948 | 33.9223 | (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 | 280.3020 | 247.8311 | 262.9855 | 230.3254 | 222.7003 | 200.0373 | 196.8812 | 204.9982 | 207.5949 | 232.2629 | 247.9468 | 277.1078 | (62) |
| WWHRS | -32.4473 | -28.6966 | -30.0495 | -24.8821 | -23.1893 | -19.8432 | -18.5998 | -19.7791 | -20.5306 | -24.2033 | -27.4194 | -31.8464 | (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 | 247.8547 | 219.1344 | 232.9361 | 205.4432 | 199.5110 | 180.1940 | 178.2814 | 185.2191 | 187.0643 | 208.0597 | 220.5275 | 245.2614 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2509.4868 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2509 | (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 | 88.9963 | 78.6066 | 83.2386 | 72.5147 | 69.8437 | 62.4439 | 61.2589 | 63.9578 | 64.9568 | 73.0233 | 78.3738 | 87.9342 | (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 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | 139.4317 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 136.9684 | 151.6436 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | 136.9684 | 141.5340 | 136.9684 | 141.5340 | 136.9684 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.6938 | 268.4509 | 261.5032 | 246.7123 | 228.0414 | 210.4935 | 198.7704 | 196.0133 | 202.9610 | 217.7519 | 236.4228 | 253.9707 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | 36.9432 | (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) | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | -111.5453 | (71) |
| Water heating gains (Table 5) | 119.6187 | 116.9741 | 111.8798 | 100.7148 | 93.8760 | 86.7276 | 82.3372 | 85.9648 | 90.2178 | 98.1496 | 108.8525 | 118.1912 | (72) |
| Total internal gains | 590.1104 | 604.8981 | 578.1809 | 556.7907 | 526.7153 | 503.5846 | 482.9055 | 483.7760 | 499.5423 | 520.6994 | 554.6388 | 576.9598 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 2.4700 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 8.0268 | (74) |
| South | 16.5300 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 236.1813 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 244.2080 | 402.1436 | 518.7854 | 598.7485 | 636.7040 | 618.8415 | 602.0234 | 574.6273 | 546.0434 | 435.4642 | 289.8574 | 210.7739 | (83) |
| Total gains | 834.3185 | 1007.0417 | 1096.9663 | 1155.5391 | 1163.4193 | 1122.4261 | 1084.9289 | 1058.4033 | 1045.5857 | 956.1637 | 844.4962 | 787.7337 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 15.4776 | 15.5150 | 15.5519 | 15.7273 | 15.7606 | 15.9173 | 15.9173 | 15.9467 | 15.8566 | 15.7606 | 15.6934 | 15.6238 | |
| alpha | 2.0318 | 2.0343 | 2.0368 | 2.0485 | 2.0507 | 2.0612 | 2.0612 | 2.0631 | 2.0571 | 2.0507 | 2.0462 | 2.0416 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| util living area | | | | | | | | | | | | |
| | 0.9099 | 0.8724 | 0.8321 | 0.7703 | 0.6864 | 0.5668 | 0.4478 | 0.4708 | 0.6195 | 0.7806 | 0.8770 | 0.9183 (86) |
| MIT | 17.7130 | 18.1692 | 18.7318 | 19.4281 | 20.0564 | 20.5639 | 20.8106 | 20.7824 | 20.4360 | 19.6117 | 18.5486 | 17.6333 (87) |
| Th 2 | 19.8770 | 19.8794 | 19.8818 | 19.8928 | 19.8949 | 19.9045 | 19.9045 | 19.9063 | 19.9008 | 19.8949 | 19.8907 | 19.8863 (88) |
| util rest of house | | | | | | | | | | | | |
| | 0.8994 | 0.8582 | 0.8127 | 0.7421 | 0.6436 | 0.5004 | 0.3566 | 0.3817 | 0.5581 | 0.7482 | 0.8608 | 0.9087 (89) |
| MIT 2 | 16.0985 | 16.6631 | 17.3597 | 18.2159 | 18.9667 | 19.5438 | 19.7875 | 19.7653 | 19.4100 | 18.4549 | 17.1503 | 16.0021 (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3269 (91) |
| MIT | 16.6262 | 17.1554 | 17.8081 | 18.6122 | 19.3228 | 19.8772 | 20.1219 | 20.0978 | 19.7453 | 18.8330 | 17.6073 | 16.5353 (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 |
| adjusted MIT | 16.6262 | 17.1554 | 17.8081 | 18.6122 | 19.3228 | 19.8772 | 20.1219 | 20.0978 | 19.7453 | 18.8330 | 17.6073 | 16.5353 (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8570 | 0.8125 | 0.7677 | 0.7033 | 0.6185 | 0.4986 | 0.3759 | 0.3984 | 0.5484 | 0.7106 | 0.8165 | 0.8678 | (94) |
| Useful gains | 714.9941 | 818.1746 | 842.0925 | 812.6729 | 719.5666 | 559.6035 | 407.8169 | 421.6431 | 573.4376 | 679.4768 | 689.5326 | 683.6346 | (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 | 1638.6022 | 1625.2597 | 1496.0880 | 1270.6020 | 995.1600 | 682.1567 | 455.2598 | 477.1110 | 732.5317 | 1074.8142 | 1377.6009 | 1624.4625 | (97) |
| Space heating kWh | 687.1644 | 542.3612 | 486.5726 | 329.7090 | 205.0415 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 294.1310 | 495.4092 | 699.9760 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3740.3648 | |
| 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 | 687.1644 | 542.3612 | 486.5726 | 329.7090 | 205.0415 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 294.1310 | 495.4092 | 699.9760 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3740.3648 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.2831 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 687.1644 | 542.3612 | 486.5726 | 329.7090 | 205.0415 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 294.1310 | 495.4092 | 699.9760 | (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) | 743.6845 | 586.9710 | 526.5938 | 356.8279 | 221.9064 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 318.3236 | 536.1571 | 757.5497 | (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 | 247.8547 | 219.1344 | 232.9361 | 205.4432 | 199.5110 | 180.1940 | 178.2814 | 185.2191 | 187.0643 | 208.0597 | 220.5275 | 245.2614 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.4458 | 86.2421 | 85.9209 | 85.3892 | 84.4401 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.1230 | 86.0609 | 86.4964 | (217) |
| Fuel for water heating, kWh/month | 286.7168 | 254.0923 | 271.1052 | 240.5961 | 236.2751 | 224.4011 | 222.0192 | 230.6589 | 232.9568 | 244.4224 | 256.2458 | 283.5511 | (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 | 28.4593 | 22.8311 | 20.5569 | 15.0609 | 11.6334 | 9.5046 | 10.6124 | 13.7944 | 17.9176 | 23.5089 | 26.5532 | 29.2503 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -19.7148 | -29.6413 | -45.3953 | -54.4772 | -61.7796 | -58.7598 | -58.0236 | -53.2497 | -45.4031 | -35.3499 | -22.3134 | -16.8349 | (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 | -6.1551 | -13.3112 | -27.1578 | -41.8511 | -56.4100 | -57.0973 | -56.4476 | -47.3146 | -34.0441 | -19.3986 | -8.3297 | -4.8421 | (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 | | | | | | | | | | | | 4048.0139 | (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 | | | | | | | | | | | | 2983.0407 | (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) | | | | | | | | | | | | 229.6831 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV generation | | | | | | | | | | | | -873.3016 | (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 | | | | | | | | | | | | 6473.4361 | (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 | 4048.0139 | 0.2100 | 850.0829 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2983.0407 | 0.2100 | 626.4386 | (264) |
| Space and water heating | | | 1476.5215 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 229.6831 | 0.1443 | 33.1504 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -500.9426 | 0.1333 | -66.7627 | |
| PV Unit electricity exported | -372.3591 | 0.1251 | -46.5975 | |
| Total | | | -113.3601 | (269) |
| Total CO2, kg/year | | | 1408.2410 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 13.2800 | (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 | 4048.0139 | 1.1300 | 4574.2557 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2983.0407 | 1.1300 | 3370.8360 | (278) |
| Space and water heating | | | 7945.0918 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 229.6831 | 1.5338 | 352.2956 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -500.9426 | 1.4925 | -747.6487 | |
| PV Unit electricity exported | -372.3591 | 0.4593 | -171.0307 | |
| Total | | | -918.6794 | (283) |
| Total Primary energy kWh/year | | | 7508.8088 | (286) |
| Target Primary Energy Rate (TPER) | | | 70.8300 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Property Reference | F5 | Issued on Date | 02/10/2024 |
| Assessment Reference | F5 | Prop Type Ref | F5 |
| Property | F5 | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 84 B | DER | 15.37 | TER | 14.45 |
| Environmental | 87 B | % DER < TER | | | -6.37 |
| $CO_2$ Emissions (t/year) | 1.27 | DFEE | 35.15 | TFEE | 43.03 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 18.30 |
| % DPER < TPER | -10.28 | DPER | 85.12 | TPER | 77.19 |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Matthew Stainrod | Assessor ID | AU83-0001 |
| Client | | | |

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

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 89.8800 | (1b) | x 2.5000 | (2b) = | 224.7000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 89.8800 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 224.7000 | (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) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1335 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3835 (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) = | 0.3260 (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 | 0.4156 | 0.4075 | 0.3993 | 0.3586 | 0.3504 | 0.3097 | 0.3097 | 0.3015 | 0.3260 | 0.3504 | 0.3667 | 0.3830 | (22b) |
| Effective ac | 0.5864 | 0.5830 | 0.5797 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5531 | 0.5614 | 0.5672 | 0.5734 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 21.2600 | 1.1450 | 24.3435 | | | (27) |
| External Wall | 65.6400 | 21.2600 | 44.3800 | 0.1500 | 6.6570 | 9.0000 | 399.4200 | (29a) |
| Communal Wall | 38.0600 | 2.1000 | 35.9600 | 0.1500 | 5.3940 | 9.0000 | 323.6400 | (29a) |
| External Roof | 89.8800 | | 89.8800 | 0.1000 | 8.9880 | 9.0000 | 808.9200 | (30) |
| Total net area of external elements Aum(A, m2) | | | 193.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 47.4825 | | | (33) |
| Party Wall | | | 28.5400 | 0.0000 | 0.0000 | 20.0000 | 570.8000 | (32) |
| Party Floor | | | 89.8800 | | | 40.0000 | 3595.2000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6597.9800 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 73.4088 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 9.6790 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 57.1615 (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 | 43.4802 | 43.2315 | 42.9878 | 41.8427 | 41.6285 | 40.6312 | 40.6312 | 40.4465 | 41.0154 | 41.6285 | 42.0619 | 42.5150 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100.6418 | 100.3931 | 100.1493 | 99.0042 | 98.7900 | 97.7927 | 97.7927 | 97.6081 | 98.1769 | 98.7900 | 99.2234 | 99.6765 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 99.0032 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1197 | 1.1170 | 1.1143 | 1.1015 | 1.0991 | 1.0880 | 1.0880 | 1.0860 | 1.0923 | 1.0991 | 1.1040 | 1.1090 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1015 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6241 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 93.7982 | 92.3886 | 90.3345 | 86.4044 | 83.5041 | 80.2697 | 78.4313 | 80.4698 | 82.7044 | 86.1772 | 90.1917 | 93.4388 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29.4587 | 29.0212 | 28.4051 | 27.2691 | 26.4185 | 25.4754 | 24.9659 | 25.5777 | 26.2438 | 27.2530 | 28.4124 | 29.3591 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 41.5031 | 39.9939 | 38.4847 | 36.9755 | 35.4663 | 33.9571 | 33.9571 | 35.4663 | 36.9755 | 38.4847 | 39.9939 | 41.5031 (42c) |

Average daily hot water use (litres/day) 151.5218 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 164.7600 | 161.4037 | 157.2243 | 150.6491 | 145.3890 | 139.7022 | 137.3543 | 141.5138 | 145.9237 | 151.9149 | 158.5980 | 164.3011 | (44) |
| Energy conte | 260.9396 | 229.8367 | 241.6480 | 206.2311 | 195.7215 | 171.7801 | 166.1181 | 175.2236 | 179.9386 | 206.1471 | 225.9519 | 257.2558 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2516.7921 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 39.1409 | 34.4755 | 36.2472 | 30.9347 | 29.3582 | 25.7670 | 24.9177 | 26.2835 | 26.9908 | 30.9221 | 33.8928 | 38.5884 | (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 | | | | | | | | | | | | | |
| | 311.8985 | 275.8641 | 292.6069 | 255.5461 | 246.6804 | 221.0952 | 217.0770 | 226.1825 | 229.2536 | 257.1060 | 275.2670 | 308.2147 | (62) |
| WWHRS | -26.6813 | -23.5971 | -24.7096 | -20.4605 | -19.0684 | -16.3170 | -15.2946 | -16.2643 | -16.8822 | -19.9023 | -22.5468 | -26.1872 | (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 | | | | | | | | | | | | | |
| | 285.2172 | 252.2670 | 267.8973 | 235.0856 | 227.6119 | 204.7782 | 201.7824 | 209.9183 | 212.3714 | 237.2038 | 252.7202 | 282.0275 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2868.8809 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2869 | (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 | | | | | | | | | | | | | |
| | 99.5021 | 87.9276 | 93.0877 | 80.9006 | 77.8171 | 69.4457 | 67.9740 | 71.0016 | 72.1583 | 81.2836 | 87.4578 | 98.2773 | (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 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 120.4758 | 133.3839 | 120.4758 | 124.4917 | 120.4758 | 124.4917 | 120.4758 | 120.4758 | 124.4917 | 120.4758 | 124.4917 | 120.4758 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 238.8568 | 241.3354 | 235.0894 | 221.7925 | 205.0076 | 189.2321 | 178.6931 | 176.2145 | 182.4605 | 195.7574 | 212.5423 | 228.3178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | (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) | | | | | | | | | | | | | |
| | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 133.7394 | 130.8446 | 125.1178 | 112.3619 | 104.5929 | 96.4523 | 91.3629 | 95.4322 | 100.2199 | 109.2522 | 121.4692 | 132.0931 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 558.4332 | 570.9250 | 546.0442 | 524.0073 | 495.4374 | 472.5372 | 452.8929 | 454.4837 | 469.5332 | 490.8465 | 523.8643 | 546.2478 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| South | 3.3000 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 47.1505 | (78) |
| Southwest | 13.0100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 146.2932 | (79) |
| Northwest | 4.9500 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 17.0687 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 210.5124 | 361.1556 | 501.9169 | 636.4358 | 727.2265 | 728.5795 | 699.6552 | 630.7166 | 548.2113 | 401.1587 | 252.5918 | 179.8780 | (83) |
| Total gains | 768.9456 | 932.0807 | 1047.9611 | 1160.4430 | 1222.6639 | 1201.1167 | 1152.5481 | 1085.2003 | 1017.7445 | 892.0052 | 776.4561 | 726.1259 | (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 | 18.2109 | 18.2560 | 18.3004 | 18.5121 | 18.5522 | 18.7414 | 18.7414 | 18.7769 | 18.6681 | 18.5522 | 18.4712 | 18.3872 | |
| alpha | 2.2141 | 2.2171 | 2.2200 | 2.2341 | 2.2368 | 2.2494 | 2.2494 | 2.2518 | 2.2445 | 2.2368 | 2.2314 | 2.2258 | |
| util living area | | | | | | | | | | | | | |
| | 0.8955 | 0.8495 | 0.7925 | 0.7017 | 0.5881 | 0.4556 | 0.3468 | 0.3785 | 0.5438 | 0.7383 | 0.8563 | 0.9054 | (86) |
| MIT | 18.2865 | 18.7422 | 19.2959 | 19.9427 | 20.4491 | 20.7821 | 20.9151 | 20.8939 | 20.6571 | 19.9824 | 19.0333 | 18.2057 | (87) |
| Th 2 | 19.9847 | 19.9870 | 19.9892 | 19.9996 | 20.0015 | 20.0106 | 20.0106 | 20.0123 | 20.0071 | 20.0015 | 19.9976 | 19.9935 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8842 | 0.8341 | 0.7715 | 0.6718 | 0.5462 | 0.3986 | 0.2765 | 0.3070 | 0.4871 | 0.7049 | 0.8390 | 0.8951 | (89) |
| MIT 2 | 17.5270 | 17.9686 | 18.5023 | 19.1195 | 19.5813 | 19.8711 | 19.9695 | 19.9584 | 19.7742 | 19.1739 | 18.2678 | 17.4542 | (90) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3858 | (91) |
| MIT | 17.8200 | 18.2671 | 18.8085 | 19.4371 | 19.9161 | 20.2226 | 20.3343 | 20.3193 | 20.1149 | 19.4859 | 18.5632 | 17.7442 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.6700 | 18.1171 | 18.6585 | 19.2871 | 19.7661 | 20.0726 | 20.1843 | 20.1693 | 19.9649 | 19.3359 | 18.4132 | 17.5942 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8512 | 0.7997 | 0.7394 | 0.6481 | 0.5356 | 0.4024 | 0.2893 | 0.3188 | 0.4846 | 0.6796 | 0.8054 | 0.8632 | (94) |
| Useful gains | 654.5419 | 745.3992 | 774.8616 | 752.1348 | 654.8088 | 483.2764 | 333.3997 | 345.9793 | 493.1510 | 606.1738 | 625.3787 | 626.8192 | (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 | 1345.5835 | 1326.9023 | 1217.6657 | 1028.3681 | 796.8506 | 535.1807 | 350.5234 | 367.9184 | 575.7976 | 863.0163 | 1122.5339 | 1335.0844 | (97) |
| Space heating kWh | 514.1349 | 390.7701 | 329.4462 | 198.8880 | 105.6791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 191.0908 | 357.9517 | 526.9493 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2614.9102 | |
| 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 | 514.1349 | 390.7701 | 329.4462 | 198.8880 | 105.6791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 191.0908 | 357.9517 | 526.9493 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2614.9102 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 29.0933 | (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 %) | | | | | | | | | | | | 88.9000 | (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 | 514.1349 | 390.7701 | 329.4462 | 198.8880 | 105.6791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 191.0908 | 357.9517 | 526.9493 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 578.3295 | 439.5614 | 370.5807 | 223.7210 | 118.8742 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 214.9503 | 402.6454 | 592.7439 | (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 | 285.2172 | 252.2670 | 267.8973 | 235.0856 | 227.6119 | 204.7782 | 201.7824 | 209.9183 | 212.3714 | 237.2038 | 252.7202 | 282.0275 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.6278 | 85.3154 | 84.8257 | 84.0252 | 82.8410 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.9222 | 85.1270 | 85.7002 | (217) |
| Fuel for water heating, kWh/month | 333.0894 | 295.6874 | 315.8210 | 279.7799 | 274.7575 | 255.0164 | 251.2857 | 261.4175 | 264.4725 | 282.6473 | 296.8742 | 329.0861 | (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 | 25.0325 | 20.0820 | 18.0816 | 13.2474 | 10.2326 | 8.3602 | 9.3346 | 12.1334 | 15.7601 | 20.6781 | 23.3559 | 25.7282 | (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) | | | | | | | | | | | | | |
| (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 | 2941.4063 | (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 | 3439.9349 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 202.0266 | (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 | 6669.3678 | (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 | 2941.4063 | 0.2100 | 617.6953 | (261) |

| | | | | |
|---|---|---|---|---|
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3439.9349 | 0.2100 | 722.3863 | (264) |
| Space and water heating | | | 1340.0816 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 202.0266 | 0.1443 | 29.1587 | (268) |
| Total CO2, kg/year | | | 1381.1696 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.3700 | (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 | 2941.4063 | 1.1300 | 3323.7891 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3439.9349 | 1.1300 | 3887.1264 | (278) |
| Space and water heating | | | 7210.9155 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 202.0266 | 1.5338 | 309.8751 | (282) |
| Total Primary energy kWh/year | | | 7650.8915 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 85.1200 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 89.8800 | (1b) | x 2.5000 | (2b) = | 224.7000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 89.8800 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 224.7000 | (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) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1335 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3835 | (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) = | 0.3260 | (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 | 0.4156 | 0.4075 | 0.3993 | 0.3586 | 0.3504 | 0.3097 | 0.3097 | 0.3015 | 0.3260 | 0.3504 | 0.3667 | 0.3830 | (22b) |
| Effective ac | 0.5864 | 0.5830 | 0.5797 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5531 | 0.5614 | 0.5672 | 0.5734 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 20.3700 | 1.1450 | 23.3244 | | | (27) |
| External Wall | 65.6400 | 20.3700 | 45.2700 | 0.1800 | 8.1486 | | | (29a) |
| Communal Wall | 38.0600 | 2.1000 | 35.9600 | 0.1800 | 6.4728 | | | (29a) |
| External Roof | 89.8800 | | 89.8800 | 0.1100 | 9.8868 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 193.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 49.9326 | | | (33) |
| Party Wall | | | 28.5400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 73.4088 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 12.8500 | 0.0500 | 0.6425 |
| E3 | Sill | 8.0000 | 0.0500 | 0.4000 |
| E4 | Jamb | 35.6500 | 0.0500 | 1.7825 |
| E7 | Party floor between dwellings (in blocks of flats) | 34.7700 | 0.0700 | 2.4339 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 6.7000 | 0.0200 | 0.1340 |
| E14 | Flat roof | 15.2200 | 0.0800 | 1.2176 |
| E15 | Flat roof with parapet | 26.2400 | 0.5600 | 14.6944 |
| E16 | Corner (normal) | 12.5000 | 0.0900 | 1.1250 |

| | | | | |
|---|---|---|---|---|
| E18 Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.4200 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 11.4200 | 0.1200 | 1.3704 | |
| E17 Corner (inverted - internal area greater than external area) | 5.0000 | -0.0900 | -0.4500 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.8003 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 73.7329 (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 | 43.4802 | 43.2315 | 42.9878 | 41.8427 | 41.6285 | 40.6312 | 40.6312 | 40.4465 | 41.0154 | 41.6285 | 42.0619 | 42.5150 | (38) |
| Heat transfer coeff | 117.2132 | 116.9645 | 116.7207 | 115.5757 | 115.3614 | 114.3642 | 114.3642 | 114.1795 | 114.7483 | 115.3614 | 115.7948 | 116.2479 | (39) |

Average = Sum(39)m / 12 = 115.5746

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3041 | 1.3013 | 1.2986 | 1.2859 | 1.2835 | 1.2724 | 1.2724 | 1.2704 | 1.2767 | 1.2835 | 1.2883 | 1.2934 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2859 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6241 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 68.2169 | 67.1917 | 65.6978 | 62.8396 | 60.7303 | 58.3780 | 57.0409 | 58.5235 | 60.1487 | 62.6743 | 65.5939 | 67.9555 | (42a) |
| Hot water usage for baths | 29.4587 | 29.0212 | 28.4051 | 27.2691 | 26.4185 | 25.4754 | 24.9659 | 25.5777 | 26.2438 | 27.2530 | 28.4124 | 29.3591 | (42b) |
| Hot water usage for other uses | 41.5031 | 39.9939 | 38.4847 | 36.9755 | 35.4663 | 33.9571 | 33.9571 | 35.4663 | 36.9755 | 38.4847 | 39.9939 | 41.5031 | (42c) |

Average daily hot water use (litres/day) 127.9367 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.1787 | 136.2068 | 132.5877 | 127.0842 | 122.6151 | 117.8104 | 115.9639 | 119.5675 | 123.3680 | 128.4121 | 134.0003 | 138.8178 | (44) |
| Energy conte | 220.4251 | 193.9567 | 203.7823 | 173.9720 | 165.0635 | 144.8617 | 140.2483 | 148.0495 | 152.1251 | 174.2540 | 190.9080 | 217.3551 | (45) |

Energy content (annual) Total = Sum(45)m = 2125.0011

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 33.0638 | 29.0935 | 30.5673 | 26.0958 | 24.7595 | 21.7293 | 21.0372 | 22.2074 | 22.8188 | 26.1381 | 28.6362 | 32.6033 | (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 | 271.3840 | 239.9841 | 254.7412 | 223.2870 | 216.0224 | 194.1767 | 191.2072 | 199.0084 | 201.4401 | 225.2129 | 240.2230 | 268.3140 | (62) |
| WWHRS | -31.1859 | -27.5811 | -28.8813 | -23.9149 | -22.2878 | -19.0718 | -17.8768 | -19.0102 | -19.7324 | -23.2624 | -26.3534 | -30.6084 | (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 | 240.1981 | 212.4030 | 225.8599 | 199.3722 | 193.7346 | 175.1049 | 173.3304 | 179.9983 | 181.7077 | 201.9505 | 213.8696 | 237.7056 | (64) |

Total per year (kWh/year) = Sum(64)m = 2435.2348 (64)

12Total per year (kWh/year) 2435 (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 | 86.0311 | 75.9975 | 80.4973 | 70.1744 | 67.6233 | 60.4953 | 59.3723 | 61.9662 | 62.9104 | 70.6792 | 75.8057 | 85.0103 | (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 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 120.4521 | 133.3577 | 120.4521 | 124.4672 | 120.4521 | 124.4672 | 120.4521 | 120.4521 | 124.4672 | 120.4521 | 124.4672 | 120.4521 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 238.8568 | 241.3354 | 235.0894 | 221.7925 | 205.0076 | 189.2321 | 178.6931 | 176.2145 | 182.4605 | 195.7574 | 212.5423 | 228.3178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | (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) | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | (71) |
| Water heating gains (Table 5) | 115.6331 | 113.0915 | 108.1953 | 97.4645 | 90.8916 | 84.0212 | 79.8015 | 83.2879 | 87.3755 | 94.9989 | 105.2856 | 114.2611 | (72) |
| Total internal gains | 540.3032 | 553.1457 | 529.0980 | 509.0854 | 481.7124 | 460.0816 | 441.3078 | 442.3156 | 456.6643 | 476.5695 | 507.6563 | 528.3922 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| South | 3.1600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 45.1502 | (78) |
| Southwest | 12.4700 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 140.2211 | (79) |
| Northwest | 4.7400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 16.3445 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 201.7158 | 346.0625 | 480.9363 | 609.8232 | 696.8087 | 698.1011 | 670.3885 | 604.3398 | 525.2927 | 384.3926 | 242.0366 | 172.3617 | (83) |
| Total gains | 742.0190 | 899.2082 | 1010.0344 | 1118.9085 | 1178.5211 | 1158.1828 | 1111.6963 | 1046.6555 | 981.9570 | 860.9621 | 749.6929 | 700.7539 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 15.6362 | 15.6695 | 15.7022 | 15.8578 | 15.8872 | 16.0258 | 16.0258 | 16.0517 | 15.9721 | 15.8872 | 15.8278 | 15.7661 | |
| alpha | 2.0424 | 2.0446 | 2.0468 | 2.0572 | 2.0591 | 2.0684 | 2.0684 | 2.0701 | 2.0648 | 2.0591 | 2.0552 | 2.0511 | |
| util living area | 0.9096 | 0.8712 | 0.8231 | 0.7444 | 0.6410 | 0.5128 | 0.3999 | 0.4336 | 0.5990 | 0.7764 | 0.8770 | 0.9181 | (86) |
| MIT | 17.7435 | 18.2044 | 18.8088 | 19.5536 | 20.1875 | 20.6452 | 20.8493 | 20.8163 | 20.4776 | 19.6399 | 18.5674 | 17.6605 | (87) |
| Th 2 | 19.8376 | 19.8398 | 19.8419 | 19.8519 | 19.8538 | 19.8625 | 19.8625 | 19.8641 | 19.8591 | 19.8538 | 19.8500 | 19.8460 | (88) |
| util rest of house | 0.8987 | 0.8562 | 0.8023 | 0.7134 | 0.5949 | 0.4452 | 0.3115 | 0.3449 | 0.5348 | 0.7422 | 0.8601 | 0.9081 | (89) |
| MIT 2 | 16.1072 | 16.6770 | 17.4222 | 18.3289 | 19.0727 | 19.5800 | 19.7745 | 19.7508 | 19.4153 | 18.4564 | 17.1441 | 16.0067 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3858 | (91) |
| MIT | 16.7385 | 17.2663 | 17.9573 | 18.8014 | 19.5029 | 19.9910 | 20.1892 | 20.1619 | 19.8252 | 18.9131 | 17.6932 | 16.6448 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.7385 | 17.2663 | 17.9573 | 18.8014 | 19.5029 | 19.9910 | 20.1892 | 20.1619 | 19.8252 | 18.9131 | 17.6932 | 16.6448 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8582 | 0.8128 | 0.7603 | 0.6804 | 0.5793 | 0.4533 | 0.3381 | 0.3694 | 0.5327 | 0.7086 | 0.8183 | 0.8691 | (94) |
| Useful gains | 636.8278 | 730.8995 | 767.9224 | 761.3497 | 682.7204 | 525.0602 | 375.8773 | 386.6803 | 523.0723 | 610.1184 | 613.4585 | 609.0112 | (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 | 1457.9609 | 1446.4183 | 1337.2992 | 1144.3643 | 900.1488 | 616.5363 | 410.4789 | 429.5342 | 656.9517 | 959.0070 | 1226.6429 | 1446.6858 | (97) |
| Space heating kWh | 610.9230 | 480.8287 | 423.6163 | 275.7705 | 161.7667 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 259.5731 | 441.4928 | 623.2299 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3277.2009 | |
| 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 | 610.9230 | 480.8287 | 423.6163 | 275.7705 | 161.7667 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 259.5731 | 441.4928 | 623.2299 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3277.2009 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 36.4620 | (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 | 610.9230 | 480.8287 | 423.6163 | 275.7705 | 161.7667 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 259.5731 | 441.4928 | 623.2299 | (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) | 661.1721 | 520.3773 | 458.4592 | 298.4529 | 175.0722 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 280.9233 | 477.8060 | 674.4912 | (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 | 240.1981 | 212.4030 | 225.8599 | 199.3722 | 193.7346 | 175.1049 | 173.3304 | 179.9983 | 181.7077 | 201.9505 | 213.8696 | 237.7056 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.2919 | 86.0755 | 85.7079 | 85.0767 | 83.9975 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.9203 | 85.8978 | 86.3467 | (217) |
| Fuel for water heating, kWh/month | 278.3554 | 246.7637 | 263.5229 | 234.3439 | 230.6433 | 218.0634 | 215.8536 | 224.1572 | 226.2860 | 237.8117 | 248.9813 | 275.2919 | (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 | 25.0276 | 20.0780 | 18.0781 | 13.2448 | 10.2306 | 8.3585 | 9.3327 | 12.1310 | 15.7570 | 20.6740 | 23.3513 | 25.7232 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -16.8614 | -25.4329 | -39.0778 | -47.0595 | -53.5203 | -50.9679 | -50.3358 | -46.1225 | -39.2171 | -30.4040 | -19.1137 | -14.3898 | (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 | -5.0722 | -10.9841 | -22.4359 | -34.6119 | -46.6861 | -47.2609 | -46.7180 | -39.1404 | -28.1417 | -16.0142 | -6.8670 | -3.9889 | (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 | 3546.7543 | (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 | 2900.0745 | (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) | 201.9869 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -740.4240 | (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 | 5994.3916 | (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 | 3546.7543 | 0.2100 | 744.8184 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2900.0745 | 0.2100 | 609.0156 | (264) |
| Space and water heating | | | 1353.8340 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 201.9869 | 0.1443 | 29.1529 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -432.5028 | 0.1332 | -57.6111 | |
| PV Unit electricity exported | -307.9213 | 0.1251 | -38.5252 | |
| Total | | | -96.1362 | (269) |
| Total CO2, kg/year | | | 1298.7800 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.4500 | (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 | 3546.7543 | 1.1300 | 4007.8323 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2900.0745 | 1.1300 | 3277.0842 | (278) |
| Space and water heating | | | 7284.9165 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 201.9869 | 1.5338 | 309.8142 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -432.5028 | 1.4922 | -645.3893 | |
| PV Unit electricity exported | -307.9213 | 0.4592 | -141.4020 | |
| Total | | | -786.7913 | (283) |
| Total Primary energy kWh/year | | | 6938.0402 | (286) |
| Target Primary Energy Rate (TPER) | | | 77.1900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Property Reference | F5 | Issued on Date | 02/10/2024 |
| Assessment Reference | F5 | Prop Type Ref | F5 |
| Property | F5 | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 84 B | DER | 15.37 | TER | 14.45 |
| Environmental | 87 B | % DER < TER | | | -6.37 |
| $CO_2$ Emissions (t/year) | 1.27 | DFEE | 35.15 | TFEE | 43.03 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 18.30 |
| % DPER < TPER | -10.28 | DPER | 85.12 | TPER | 77.19 |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Matthew Stainrod | Assessor ID | AU83-0001 |
| Client | | | |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 89.8800 | (1b) | x 2.5000 | (2b) = | 224.7000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 89.8800 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 224.7000 | (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) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1335 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3835 | (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) = | 0.3260 | (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 | 0.4156 | 0.4075 | 0.3993 | 0.3586 | 0.3504 | 0.3097 | 0.3097 | 0.3015 | 0.3260 | 0.3504 | 0.3667 | 0.3830 | (22b) |

| | | |
|---|---|---|
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.0000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 0.0000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5864 | 0.5830 | 0.5797 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5531 | 0.5614 | 0.5672 | 0.5734 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 21.2600 | 1.1450 | 24.3435 | | | (27) |
| External Wall | 65.6400 | 21.2600 | 44.3800 | 0.1500 | 6.6570 | 9.0000 | 399.4200 | (29a) |
| Communal Wall | 38.0600 | 2.1000 | 35.9600 | 0.1500 | 5.3940 | 9.0000 | 323.6400 | (29a) |
| External Roof | 89.8800 | | 89.8800 | 0.1000 | 8.9880 | 9.0000 | 808.9200 | (30) |
| Total net area of external elements Aum(A, m2) | | | 193.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 47.4825 | | | (33) |
| Party Wall | | | 28.5400 | 0.0000 | 0.0000 | 20.0000 | 570.8000 | (32) |
| Party Floor | | | 89.8800 | | | 40.0000 | 3595.2000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6597.9800 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 73.4088 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 9.6790 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 57.1615 (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 | 43.4802 | 43.2315 | 42.9878 | 41.8427 | 41.6285 | 40.6312 | 40.6312 | 40.4465 | 41.0154 | 41.6285 | 42.0619 | 42.5150 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 100.6418 | 100.3931 | 100.1493 | 99.0042 | 98.7900 | 97.7927 | 97.7927 | 97.6081 | 98.1769 | 98.7900 | 99.2234 | 99.6765 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 99.0032 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1197 | 1.1170 | 1.1143 | 1.1015 | 1.0991 | 1.0880 | 1.0880 | 1.0860 | 1.0923 | 1.0991 | 1.1040 | 1.1090 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1015 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.6241 | (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 | | | | | | | | | | | | | |
| | 29.4587 | 29.0212 | 28.4051 | 27.2691 | 26.4185 | 25.4754 | 24.9659 | 25.5777 | 26.2438 | 27.2530 | 28.4124 | 29.3591 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 41.5031 | 39.9939 | 38.4847 | 36.9755 | 35.4663 | 33.9571 | 33.9571 | 35.4663 | 36.9755 | 38.4847 | 39.9939 | 41.5031 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 65.0430 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 70.9619 | 69.0151 | 66.8898 | 64.2447 | 61.8849 | 59.4325 | 58.9230 | 61.0440 | 63.2193 | 65.7378 | 68.4063 | 70.8623 | (44) |
| Energy conte | 112.3862 | 98.2766 | 102.8072 | 87.9477 | 83.3089 | 73.0792 | 71.2623 | 75.5852 | 77.9558 | 89.2055 | 97.4574 | 110.9532 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1080.2252 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 95.5283 | 83.5351 | 87.3861 | 74.7556 | 70.8126 | 62.1173 | 60.5729 | 64.2474 | 66.2624 | 75.8247 | 82.8388 | 94.3102 | (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 | | | | | | | | | | | | | |
| | 95.5283 | 83.5351 | 87.3861 | 74.7556 | 70.8126 | 62.1173 | 60.5729 | 64.2474 | 66.2624 | 75.8247 | 82.8388 | 94.3102 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 918.1914 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 918 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 54.6303 | 48.6761 | 53.1524 | 50.7227 | 51.6745 | 49.2924 | 50.9355 | 51.6745 | 50.7227 | 53.1524 | 52.1529 | 54.6303 | (64a) |
| | | | | | | | | | | | | | |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 621.4168 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 37.5397 | 33.0528 | 35.1346 | 31.3696 | 30.6218 | 27.8524 | 27.8771 | 28.9805 | 29.2463 | 32.2443 | 33.7479 | 37.2351 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 120.4758 | 133.3839 | 120.4758 | 124.4917 | 120.4758 | 124.4917 | 120.4758 | 120.4758 | 124.4917 | 120.4758 | 124.4917 | 120.4758 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 238.8568 | 241.3354 | 235.0894 | 221.7925 | 205.0076 | 189.2321 | 178.6931 | 176.2145 | 182.4605 | 195.7574 | 212.5423 | 228.3178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | (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) | | | | | | | | | | | | | |
| | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 50.4565 | 49.1857 | 47.2240 | 43.5688 | 41.1583 | 38.6839 | 37.4692 | 38.9523 | 40.6198 | 43.3391 | 46.8721 | 50.0472 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 472.1503 | 486.2662 | 465.1503 | 452.2142 | 429.0028 | 414.7688 | 398.9993 | 398.0037 | 409.9331 | 421.9334 | 446.2672 | 461.2020 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| South | 3.3000 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 47.1505 | (78) |
| Southwest | 13.0100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 146.2932 | (79) |
| Northwest | 4.9500 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 17.0687 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 210.5124 | 361.1556 | 501.9169 | 636.4358 | 727.2265 | 728.5795 | 699.6552 | 630.7166 | 548.2113 | 401.1587 | 252.5918 | 179.8780 | (83) |
| Total gains | 682.6627 | 847.4218 | 967.0672 | 1088.6499 | 1156.2293 | 1143.3483 | 1098.6545 | 1028.7203 | 958.1444 | 823.0921 | 698.8590 | 641.0800 | (84) |

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7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 18.2109 | 18.2560 | 18.3004 | 18.5121 | 18.5522 | 18.7414 | 18.7414 | 18.7769 | 18.6681 | 18.5522 | 18.4712 | 18.3872 | |
| alpha | 2.2141 | 2.2171 | 2.2200 | 2.2341 | 2.2368 | 2.2494 | 2.2494 | 2.2518 | 2.2445 | 2.2368 | 2.2314 | 2.2258 | |
| util living area | | | | | | | | | | | | | |
| | 0.9145 | 0.8701 | 0.8144 | 0.7231 | 0.6087 | 0.4730 | 0.3613 | 0.3957 | 0.5661 | 0.7635 | 0.8782 | 0.9237 | (86) |
| MIT | 18.1107 | 18.5931 | 19.1782 | 19.8681 | 20.4069 | 20.7643 | 20.9075 | 20.8836 | 20.6266 | 19.8994 | 18.8927 | 18.0264 | (87) |
| Th 2 | 19.9847 | 19.9870 | 19.9892 | 19.9996 | 20.0015 | 20.0106 | 20.0106 | 20.0123 | 20.0071 | 20.0015 | 19.9976 | 19.9935 | (88) |
| util rest of house | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.9049 | 0.8562 | 0.7948 | 0.6940 | 0.5668 | 0.4149 | 0.2888 | 0.3219 | 0.5090 | 0.7316 | 0.8629 | 0.9151 | (89) |
| MIT 2 | 17.3569 | 17.8265 | 18.3929 | 19.0533 | 19.5470 | 19.8590 | 19.9656 | 19.9528 | 19.7518 | 19.1006 | 18.1346 | 17.2802 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3858 | (91) |
| MIT | 17.6477 | 18.1223 | 18.6959 | 19.3677 | 19.8788 | 20.2083 | 20.3290 | 20.3120 | 20.0893 | 19.4088 | 18.4271 | 17.5681 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.6477 | 18.1223 | 18.6959 | 19.3677 | 19.8788 | 20.2083 | 20.3290 | 20.3120 | 20.0893 | 19.4088 | 18.4271 | 17.5681 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8760 | 0.8250 | 0.7654 | 0.6736 | 0.5613 | 0.4270 | 0.3128 | 0.3451 | 0.5140 | 0.7101 | 0.8330 | 0.8876 | (94) |
| Useful gains | 598.0452 | 699.1272 | 740.1636 | 733.3455 | 648.9618 | 488.2493 | 343.7039 | 354.9937 | 492.4996 | 584.4465 | 582.1754 | 569.0033 | (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 | | | | | | | | | | | | | |
| | 1343.3407 | 1327.4276 | 1221.4095 | 1036.3484 | 807.9816 | 548.4508 | 364.6731 | 381.8381 | 588.0156 | 870.2237 | 1123.9121 | 1332.4874 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 554.4998 | 422.2179 | 358.0469 | 218.1621 | 118.3108 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 212.6182 | 390.0504 | 568.0322 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2841.9383 | |
| 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 | | | | | | | | | | | | | |
| | 554.4998 | 422.2179 | 358.0469 | 218.1621 | 118.3108 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 212.6182 | 390.0504 | 568.0322 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2841.9383 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 31.6193 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 919.2517 | 723.6663 | 741.8212 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7989 | 0.8498 | 0.8281 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 734.3680 | 614.9529 | 614.2671 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1289.0974 | 1239.1943 | 1159.8155 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 399.4052 | 464.4356 | 405.8880 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 99.8513 | 116.1089 | 101.4720 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 317.4322 | (107) |
| Energy for space heating | | | | | | | | | | | | 31.6193 | (99) |
| Energy for space cooling | | | | | | | | | | | | 3.5317 | (108) |
| Total | | | | | | | | | | | | 35.1510 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 35.2 | (109) |

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

## 1. Overall dwelling characteristics

| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 89.8800 | (1b) | x 2.5000 | (2b) = | 224.7000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 89.8800 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 224.7000 | (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) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1335 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3835 | (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) = | 0.3260 | (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 | | | | | | | | | | | | |
| | 0.4156 | 0.4075 | 0.3993 | 0.3586 | 0.3504 | 0.3097 | 0.3097 | 0.3015 | 0.3260 | 0.3504 | 0.3667 | 0.3830 (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 0.0000 (23c) |
| Effective ac | 0.5864 | 0.5830 | 0.5797 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5531 | 0.5614 | 0.5672 | 0.5734 (25) |

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## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 20.3700 | 1.1450 | 23.3244 | | | (27) |
| External Wall | 65.6400 | 20.3700 | 45.2700 | 0.1800 | 8.1486 | | | (29a) |
| Communal Wall | 38.0600 | 2.1000 | 35.9600 | 0.1800 | 6.4728 | | | (29a) |
| External Roof | 89.8800 | | 89.8800 | 0.1100 | 9.8868 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 193.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 49.9326 | | | (33) |
| Party Wall | | | 28.5400 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 73.4088 | (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 12.8500 | 0.0500 | 0.6425 |
| E3 Sill | 8.0000 | 0.0500 | 0.4000 |
| E4 Jamb | 35.6500 | 0.0500 | 1.7825 |
| E7 Party floor between dwellings (in blocks of flats) | 34.7700 | 0.0700 | 2.4339 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 6.7000 | 0.0200 | 0.1340 |
| E14 Flat roof | 15.2200 | 0.0800 | 1.2176 |
| E15 Flat roof with parapet | 26.2400 | 0.5600 | 14.6944 |
| E16 Corner (normal) | 12.5000 | 0.0900 | 1.1250 |
| E18 Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.4200 | 0.0000 | 0.0000 |
| P4 Party wall - Roof (insulation at ceiling level) | 11.4200 | 0.1200 | 1.3704 |
| E17 Corner (inverted - internal area greater than external area) | 5.0000 | -0.0900 | -0.4500 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 23.8003 | (36) |
| Point Thermal bridges (36a) = | 0.0000 | |
| Total fabric heat loss (33) + (36) + (36a) = | 73.7329 | (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 | 43.4802 | 43.2315 | 42.9878 | 41.8427 | 41.6285 | 40.6312 | 40.6312 | 40.4465 | 41.0154 | 41.6285 | 42.0619 | 42.5150 | (38) |
| Heat transfer coeff | 117.2132 | 116.9645 | 116.7207 | 115.5757 | 115.3614 | 114.3642 | 114.3642 | 114.1795 | 114.7483 | 115.3614 | 115.7948 | 116.2479 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 115.5746 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3041 | 1.3013 | 1.2986 | 1.2859 | 1.2835 | 1.2724 | 1.2724 | 1.2704 | 1.2767 | 1.2835 | 1.2883 | 1.2934 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2859 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

---

| | | |
|---|---|---|
| Assumed occupancy | 2.6241 | (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 | | | | | | | | | | | | | |
| | 29.4587 | 29.0212 | 28.4051 | 27.2691 | 26.4185 | 25.4754 | 24.9659 | 25.5777 | 26.2438 | 27.2530 | 28.4124 | 29.3591 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 41.5031 | 39.9939 | 38.4847 | 36.9755 | 35.4663 | 33.9571 | 33.9571 | 35.4663 | 36.9755 | 38.4847 | 39.9939 | 41.5031 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 65.0430 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 70.9619 | 69.0151 | 66.8898 | 64.2447 | 61.8849 | 59.4325 | 58.9230 | 61.0440 | 63.2193 | 65.7378 | 68.4063 | 70.8623 | (44) |
| Energy conte | 112.3862 | 98.2766 | 102.8072 | 87.9477 | 83.3089 | 73.0792 | 71.2623 | 75.5852 | 77.9558 | 89.2055 | 97.4574 | 110.9532 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1080.2252 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 95.5283 | 83.5351 | 87.3861 | 74.7556 | 70.8126 | 62.1173 | 60.5729 | 64.2474 | 66.2624 | 75.8247 | 82.8388 | 94.3102 | (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 | | | | | | | | | | | | | |
| | 95.5283 | 83.5351 | 87.3861 | 74.7556 | 70.8126 | 62.1173 | 60.5729 | 64.2474 | 66.2624 | 75.8247 | 82.8388 | 94.3102 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 918.1914 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 918 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 54.6303 | 48.6761 | 53.1524 | 50.7227 | 51.6745 | 49.2924 | 50.9355 | 51.6745 | 50.7227 | 53.1524 | 52.1529 | 54.6303 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 621.4168 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 37.5397 | 33.0528 | 35.1346 | 31.3696 | 30.6218 | 27.8524 | 27.8771 | 28.9805 | 29.2463 | 32.2443 | 33.7479 | 37.2351 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 120.4521 | 133.3577 | 120.4521 | 124.4672 | 120.4521 | 124.4672 | 120.4521 | 120.4521 | 124.4672 | 120.4521 | 124.4672 | 120.4521 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 238.8568 | 241.3354 | 235.0894 | 221.7925 | 205.0076 | 189.2321 | 178.6931 | 176.2145 | 182.4605 | 195.7574 | 212.5423 | 228.3178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | (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) | | | | | | | | | | | | | |
| | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 50.4565 | 49.1857 | 47.2240 | 43.5688 | 41.1583 | 38.6839 | 37.4692 | 38.9523 | 40.6198 | 43.3391 | 46.8721 | 50.0472 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 472.1266 | 486.2399 | 465.1266 | 452.1897 | 428.9791 | 414.7443 | 398.9756 | 397.9800 | 409.9086 | 421.9097 | 446.2428 | 461.1783 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| South | 3.1600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 45.1502 | (78) |
| Southwest | 12.4700 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 140.2211 | (79) |
| Northwest | 4.7400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 16.3445 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 201.7158 | 346.0625 | 480.9363 | 609.8232 | 696.8087 | 698.1011 | 670.3885 | 604.3398 | 525.2927 | 384.3926 | 242.0366 | 172.3617 | (83) |
| Total gains | 673.8424 | 832.3025 | 946.0630 | 1062.0128 | 1125.7878 | 1112.8455 | 1069.3641 | 1002.3198 | 935.2013 | 806.3023 | 688.2793 | 633.5400 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 15.6362 | 15.6695 | 15.7022 | 15.8578 | 15.8872 | 16.0258 | 16.0258 | 16.0517 | 15.9721 | 15.8872 | 15.8278 | 15.7661 | |
| alpha | 2.0424 | 2.0446 | 2.0468 | 2.0572 | 2.0591 | 2.0684 | 2.0684 | 2.0701 | 2.0648 | 2.0591 | 2.0552 | 2.0511 | |
| util living area | | | | | | | | | | | | | |
| | 0.9227 | 0.8853 | 0.8384 | 0.7599 | 0.6568 | 0.5269 | 0.4124 | 0.4481 | 0.6162 | 0.7943 | 0.8921 | 0.9306 | (86) |
| MIT | 17.6083 | 18.0862 | 18.7117 | 19.4874 | 20.1464 | 20.6258 | 20.8401 | 20.8043 | 20.4470 | 19.5683 | 18.4563 | 17.5235 | (87) |
| Th 2 | 19.8376 | 19.8398 | 19.8419 | 19.8519 | 19.8538 | 19.8625 | 19.8625 | 19.8641 | 19.8591 | 19.8538 | 19.8500 | 19.8460 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9131 | 0.8716 | 0.8188 | 0.7298 | 0.6111 | 0.4587 | 0.3221 | 0.3576 | 0.5521 | 0.7617 | 0.8768 | 0.9220 | (89) |
| MIT 2 | 16.7755 | 17.2420 | 17.8503 | 18.5970 | 19.2069 | 19.6276 | 19.7888 | 19.7687 | 19.4882 | 18.6933 | 17.6197 | 16.6975 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3858 | (91) |
| MIT | 17.0968 | 17.5677 | 18.1827 | 18.9406 | 19.5694 | 20.0128 | 20.1945 | 20.1683 | 19.8582 | 19.0309 | 17.9425 | 17.0162 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.0968 | 17.5677 | 18.1827 | 18.9406 | 19.5694 | 20.0128 | 20.1945 | 20.1683 | 19.8582 | 19.0309 | 17.9425 | 17.0162 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8822 | 0.8371 | 0.7843 | 0.7022 | 0.5985 | 0.4683 | 0.3498 | 0.3833 | 0.5521 | 0.7338 | 0.8437 | 0.8926 | (94) |
| Useful gains | 594.4878 | 696.7022 | 741.9923 | 745.7658 | 673.8289 | 521.1967 | 374.0825 | 384.1823 | 516.2887 | 591.6431 | 580.7350 | 565.5004 | (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 | | | | | | | | | | | | | |
| | 1499.9570 | 1481.6741 | 1363.6091 | 1160.4458 | 907.8237 | 619.0251 | 411.0797 | 430.2629 | 660.7407 | 972.6018 | 1255.5082 | 1489.8567 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 673.6691 | 527.5011 | 462.4829 | 298.5696 | 174.0922 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 283.4333 | 485.8366 | 687.7211 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3593.3059 | |
| 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 | | | | | | | | | | | | | |
| | 673.6691 | 527.5011 | 462.4829 | 298.5696 | 174.0922 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 283.4333 | 485.8366 | 687.7211 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3593.3059 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 39.9789 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1075.0231 | 846.2947 | 867.7640 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7242 | 0.7834 | 0.7579 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 778.5762 | 663.0234 | 657.6475 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1253.4714 | 1204.9842 | 1128.9826 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 341.9245 | 403.2188 | 350.6733 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | | fC = cooled area / (4) = | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 85.4811 | 100.8047 | 87.6683 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 273.9542 | (107) |
| Energy for space heating | | | | | | | | | | | | 39.9789 | (99) |
| Energy for space cooling | | | | | | | | | | | | 3.0480 | (108) |
| Total | | | | | | | | | | | | 43.0269 | (109) |
| Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 43.0 | (109) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Property Reference | F5 | Issued on Date | 02/10/2024 |
| Assessment Reference | F5 | Prop Type Ref | F5 |
| Property | F5 | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 84 B | DER | 15.37 | TER | 14.45 |
| Environmental | 87 B | % DER < TER | | | -6.37 |
| $CO_2$ Emissions (t/year) | 1.27 | DFEE | 35.15 | TFEE | 43.03 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 18.30 |
| % DPER < TPER | -10.28 | DPER | 85.12 | TPER | 77.19 |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Matthew Stainrod | Assessor ID | AU83-0001 |
| Client | | | |

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

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 89.8800 | (1b) | x 2.5000 | (2b) = | 224.7000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 89.8800 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 224.7000 | (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) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1335 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3835 (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) = | 0.3260 (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 | 0.4156 | 0.4075 | 0.3993 | 0.3586 | 0.3504 | 0.3097 | 0.3097 | 0.3015 | 0.3260 | 0.3504 | 0.3667 | 0.3830 | (22b) |
| Effective ac | 0.5864 | 0.5830 | 0.5797 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5531 | 0.5614 | 0.5672 | 0.5734 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 21.2600 | 1.1450 | 24.3435 | | | (27) |
| External Wall | 65.6400 | 21.2600 | 44.3800 | 0.1500 | 6.6570 | 9.0000 | 399.4200 | (29a) |
| Communal Wall | 38.0600 | 2.1000 | 35.9600 | 0.1500 | 5.3940 | 9.0000 | 323.6400 | (29a) |
| External Roof | 89.8800 | | 89.8800 | 0.1000 | 8.9880 | 9.0000 | 808.9200 | (30) |
| Total net area of external elements Aum(A, m2) | | | 193.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 47.4825 | | | (33) |
| Party Wall | | | 28.5400 | 0.0000 | 0.0000 | 20.0000 | 570.8000 | (32) |
| Party Floor | | | 89.8800 | | | 40.0000 | 3595.2000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6597.9800 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 73.4088 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 9.6790 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 57.1615 (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 | 43.4802 | 43.2315 | 42.9878 | 41.8427 | 41.6285 | 40.6312 | 40.6312 | 40.4465 | 41.0154 | 41.6285 | 42.0619 | 42.5150 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100.6418 | 100.3931 | 100.1493 | 99.0042 | 98.7900 | 97.7927 | 97.7927 | 97.6081 | 98.1769 | 98.7900 | 99.2234 | 99.6765 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 99.0032 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1197 | 1.1170 | 1.1143 | 1.1015 | 1.0991 | 1.0880 | 1.0880 | 1.0860 | 1.0923 | 1.0991 | 1.1040 | 1.1090 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1015 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6241 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 93.7982 | 92.3886 | 90.3345 | 86.4044 | 83.5041 | 80.2697 | 78.4313 | 80.4698 | 82.7044 | 86.1772 | 90.1917 | 93.4388 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29.4587 | 29.0212 | 28.4051 | 27.2691 | 26.4185 | 25.4754 | 24.9659 | 25.5777 | 26.2438 | 27.2530 | 28.4124 | 29.3591 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 41.5031 | 39.9939 | 38.4847 | 36.9755 | 35.4663 | 33.9571 | 33.9571 | 35.4663 | 36.9755 | 38.4847 | 39.9939 | 41.5031 (42c) |

Average daily hot water use (litres/day) 151.5218 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 164.7600 | 161.4037 | 157.2243 | 150.6491 | 145.3890 | 139.7022 | 137.3543 | 141.5138 | 145.9237 | 151.9149 | 158.5980 | 164.3011 | (44) |
| Energy conte | 260.9396 | 229.8367 | 241.6480 | 206.2311 | 195.7215 | 171.7801 | 166.1181 | 175.2236 | 179.9386 | 206.1471 | 225.9519 | 257.2558 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2516.7921 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 39.1409 | 34.4755 | 36.2472 | 30.9347 | 29.3582 | 25.7670 | 24.9177 | 26.2835 | 26.9908 | 30.9221 | 33.8928 | 38.5884 | (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 | | | | | | | | | | | | | |
| | 311.8985 | 275.8641 | 292.6069 | 255.5461 | 246.6804 | 221.0952 | 217.0770 | 226.1825 | 229.2536 | 257.1060 | 275.2670 | 308.2147 | (62) |
| WWHRS | -26.6813 | -23.5971 | -24.7096 | -20.4605 | -19.0684 | -16.3170 | -15.2946 | -16.2643 | -16.8822 | -19.9023 | -22.5468 | -26.1872 | (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 | | | | | | | | | | | | | |
| | 285.2172 | 252.2670 | 267.8973 | 235.0856 | 227.6119 | 204.7782 | 201.7824 | 209.9183 | 212.3714 | 237.2038 | 252.7202 | 282.0275 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2868.8809 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2869 | (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 | | | | | | | | | | | | | |
| | 99.5021 | 87.9276 | 93.0877 | 80.9006 | 77.8171 | 69.4457 | 67.9740 | 71.0016 | 72.1583 | 81.2836 | 87.4578 | 98.2773 | (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 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 120.4758 | 133.3839 | 120.4758 | 124.4917 | 120.4758 | 124.4917 | 120.4758 | 120.4758 | 124.4917 | 120.4758 | 124.4917 | 120.4758 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 238.8568 | 241.3354 | 235.0894 | 221.7925 | 205.0076 | 189.2321 | 178.6931 | 176.2145 | 182.4605 | 195.7574 | 212.5423 | 228.3178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | (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) | | | | | | | | | | | | | |
| | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 133.7394 | 130.8446 | 125.1178 | 112.3619 | 104.5929 | 96.4523 | 91.3629 | 95.4322 | 100.2199 | 109.2522 | 121.4692 | 132.0931 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 558.4332 | 570.9250 | 546.0442 | 524.0073 | 495.4374 | 472.5372 | 452.8929 | 454.4837 | 469.5332 | 490.8465 | 523.8643 | 546.2478 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| South | 3.3000 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 47.1505 | (78) |
| Southwest | 13.0100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 146.2932 | (79) |
| Northwest | 4.9500 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 17.0687 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 210.5124 | 361.1556 | 501.9169 | 636.4358 | 727.2265 | 728.5795 | 699.6552 | 630.7166 | 548.2113 | 401.1587 | 252.5918 | 179.8780 | (83) |
| Total gains | 768.9456 | 932.0807 | 1047.9611 | 1160.4430 | 1222.6639 | 1201.1167 | 1152.5481 | 1085.2003 | 1017.7445 | 892.0052 | 776.4561 | 726.1259 | (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 | 18.2109 | 18.2560 | 18.3004 | 18.5121 | 18.5522 | 18.7414 | 18.7414 | 18.7769 | 18.6681 | 18.5522 | 18.4712 | 18.3872 | |
| alpha | 2.2141 | 2.2171 | 2.2200 | 2.2341 | 2.2368 | 2.2494 | 2.2494 | 2.2518 | 2.2445 | 2.2368 | 2.2314 | 2.2258 | |
| util living area | | | | | | | | | | | | | |
| | 0.8955 | 0.8495 | 0.7925 | 0.7017 | 0.5881 | 0.4556 | 0.3468 | 0.3785 | 0.5438 | 0.7383 | 0.8563 | 0.9054 | (86) |
| MIT | 18.2865 | 18.7422 | 19.2959 | 19.9427 | 20.4491 | 20.7821 | 20.9151 | 20.8939 | 20.6571 | 19.9824 | 19.0333 | 18.2057 | (87) |
| Th 2 | 19.9847 | 19.9870 | 19.9892 | 19.9996 | 20.0015 | 20.0106 | 20.0106 | 20.0123 | 20.0071 | 20.0015 | 19.9976 | 19.9935 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8842 | 0.8341 | 0.7715 | 0.6718 | 0.5462 | 0.3986 | 0.2765 | 0.3070 | 0.4871 | 0.7049 | 0.8390 | 0.8951 | (89) |
| MIT 2 | 17.5270 | 17.9686 | 18.5023 | 19.1195 | 19.5813 | 19.8711 | 19.9695 | 19.9584 | 19.7742 | 19.1739 | 18.2678 | 17.4542 | (90) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3858 | (91) |
| MIT | 17.8200 | 18.2671 | 18.8085 | 19.4371 | 19.9161 | 20.2226 | 20.3343 | 20.3193 | 20.1149 | 19.4859 | 18.5632 | 17.7442 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.6700 | 18.1171 | 18.6585 | 19.2871 | 19.7661 | 20.0726 | 20.1843 | 20.1693 | 19.9649 | 19.3359 | 18.4132 | 17.5942 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8512 | 0.7997 | 0.7394 | 0.6481 | 0.5356 | 0.4024 | 0.2893 | 0.3188 | 0.4846 | 0.6796 | 0.8054 | 0.8632 | (94) |
| Useful gains | 654.5419 | 745.3992 | 774.8616 | 752.1348 | 654.8088 | 483.2764 | 333.3997 | 345.9793 | 493.1510 | 606.1738 | 625.3787 | 626.8192 | (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 | 1345.5835 | 1326.9023 | 1217.6657 | 1028.3681 | 796.8506 | 535.1807 | 350.5234 | 367.9184 | 575.7976 | 863.0163 | 1122.5339 | 1335.0844 | (97) |
| Space heating kWh | 514.1349 | 390.7701 | 329.4462 | 198.8880 | 105.6791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 191.0908 | 357.9517 | 526.9493 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2614.9102 | |
| 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 | 514.1349 | 390.7701 | 329.4462 | 198.8880 | 105.6791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 191.0908 | 357.9517 | 526.9493 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2614.9102 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 29.0933 | (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 %) | | | | | | | | | | | | 88.9000 | (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 | 514.1349 | 390.7701 | 329.4462 | 198.8880 | 105.6791 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 191.0908 | 357.9517 | 526.9493 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 578.3295 | 439.5614 | 370.5807 | 223.7210 | 118.8742 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 214.9503 | 402.6454 | 592.7439 | (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 | 285.2172 | 252.2670 | 267.8973 | 235.0856 | 227.6119 | 204.7782 | 201.7824 | 209.9183 | 212.3714 | 237.2038 | 252.7202 | 282.0275 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.6278 | 85.3154 | 84.8257 | 84.0252 | 82.8410 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 83.9222 | 85.1270 | 85.7002 | (217) |
| Fuel for water heating, kWh/month | 333.0894 | 295.6874 | 315.8210 | 279.7799 | 274.7575 | 255.0164 | 251.2857 | 261.4175 | 264.4725 | 282.6473 | 296.8742 | 329.0861 | (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 | 25.0325 | 20.0820 | 18.0816 | 13.2474 | 10.2326 | 8.3602 | 9.3346 | 12.1334 | 15.7601 | 20.6781 | 23.3559 | 25.7282 | (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) | | | | | | | | | | | | | |
| (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 | 2941.4063 | (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 | 3439.9349 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 202.0266 | (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 | 6669.3678 | (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 | 2941.4063 | 0.2100 | 617.6953 | (261) |

| | | | | |
|---|---|---|---|---|
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3439.9349 | 0.2100 | 722.3863 | (264) |
| Space and water heating | | | 1340.0816 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 202.0266 | 0.1443 | 29.1587 | (268) |
| Total CO2, kg/year | | | 1381.1696 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.3700 | (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 | 2941.4063 | 1.1300 | 3323.7891 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3439.9349 | 1.1300 | 3887.1264 | (278) |
| Space and water heating | | | 7210.9155 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 202.0266 | 1.5338 | 309.8751 | (282) |
| Total Primary energy kWh/year | | | 7650.8915 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 85.1200 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 89.8800 | (1b) | x 2.5000 | (2b) = | 224.7000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 89.8800 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 224.7000 | (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) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1335 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3835 | (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) = | 0.3260 | (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 | 0.4156 | 0.4075 | 0.3993 | 0.3586 | 0.3504 | 0.3097 | 0.3097 | 0.3015 | 0.3260 | 0.3504 | 0.3667 | 0.3830 | (22b) |
| Effective ac | 0.5864 | 0.5830 | 0.5797 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5531 | 0.5614 | 0.5672 | 0.5734 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 20.3700 | 1.1450 | 23.3244 | | | (27) |
| External Wall | 65.6400 | 20.3700 | 45.2700 | 0.1800 | 8.1486 | | | (29a) |
| Communal Wall | 38.0600 | 2.1000 | 35.9600 | 0.1800 | 6.4728 | | | (29a) |
| External Roof | 89.8800 | | 89.8800 | 0.1100 | 9.8868 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 193.5800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 49.9326 | | | (33) |
| Party Wall | | | 28.5400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 73.4088 (35)

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 12.8500 | 0.0500 | 0.6425 |
| E3 | Sill | 8.0000 | 0.0500 | 0.4000 |
| E4 | Jamb | 35.6500 | 0.0500 | 1.7825 |
| E7 | Party floor between dwellings (in blocks of flats) | 34.7700 | 0.0700 | 2.4339 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 6.7000 | 0.0200 | 0.1340 |
| E14 | Flat roof | 15.2200 | 0.0800 | 1.2176 |
| E15 | Flat roof with parapet | 26.2400 | 0.5600 | 14.6944 |
| E16 | Corner (normal) | 12.5000 | 0.0900 | 1.1250 |

| | | | | |
|---|---|---|---|---|
| E18 Party wall between dwellings | 7.5000 | 0.0600 | 0.4500 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.4200 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 11.4200 | 0.1200 | 1.3704 | |
| E17 Corner (inverted - internal area greater than external area) | 5.0000 | -0.0900 | -0.4500 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.8003 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 73.7329 (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 | 43.4802 | 43.2315 | 42.9878 | 41.8427 | 41.6285 | 40.6312 | 40.6312 | 40.4465 | 41.0154 | 41.6285 | 42.0619 | 42.5150 | (38) |
| Heat transfer coeff | 117.2132 | 116.9645 | 116.7207 | 115.5757 | 115.3614 | 114.3642 | 114.3642 | 114.1795 | 114.7483 | 115.3614 | 115.7948 | 116.2479 | (39) |

Average = Sum(39)m / 12 = 115.5746

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3041 | 1.3013 | 1.2986 | 1.2859 | 1.2835 | 1.2724 | 1.2724 | 1.2704 | 1.2767 | 1.2835 | 1.2883 | 1.2934 | (40) |
| HLP (average) | | | | | | | | | | | | 1.2859 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6241 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 68.2169 | 67.1917 | 65.6978 | 62.8396 | 60.7303 | 58.3780 | 57.0409 | 58.5235 | 60.1487 | 62.6743 | 65.5939 | 67.9555 | (42a) |
| Hot water usage for baths | 29.4587 | 29.0212 | 28.4051 | 27.2691 | 26.4185 | 25.4754 | 24.9659 | 25.5777 | 26.2438 | 27.2530 | 28.4124 | 29.3591 | (42b) |
| Hot water usage for other uses | 41.5031 | 39.9939 | 38.4847 | 36.9755 | 35.4663 | 33.9571 | 33.9571 | 35.4663 | 36.9755 | 38.4847 | 39.9939 | 41.5031 | (42c) |

Average daily hot water use (litres/day) 127.9367 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 139.1787 | 136.2068 | 132.5877 | 127.0842 | 122.6151 | 117.8104 | 115.9639 | 119.5675 | 123.3680 | 128.4121 | 134.0003 | 138.8178 | (44) |
| Energy conte | 220.4251 | 193.9567 | 203.7823 | 173.9720 | 165.0635 | 144.8617 | 140.2483 | 148.0495 | 152.1251 | 174.2540 | 190.9080 | 217.3551 | (45) |

Energy content (annual) Total = Sum(45)m = 2125.0011

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 33.0638 | 29.0935 | 30.5673 | 26.0958 | 24.7595 | 21.7293 | 21.0372 | 22.2074 | 22.8188 | 26.1381 | 28.6362 | 32.6033 | (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 | 271.3840 | 239.9841 | 254.7412 | 223.2870 | 216.0224 | 194.1767 | 191.2072 | 199.0084 | 201.4401 | 225.2129 | 240.2230 | 268.3140 | (62) |
| WWHRS | -31.1859 | -27.5811 | -28.8813 | -23.9149 | -22.2878 | -19.0718 | -17.8768 | -19.0102 | -19.7324 | -23.2624 | -26.3534 | -30.6084 | (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 | 240.1981 | 212.4030 | 225.8599 | 199.3722 | 193.7346 | 175.1049 | 173.3304 | 179.9983 | 181.7077 | 201.9505 | 213.8696 | 237.7056 | (64) |

Total per year (kWh/year) = Sum(64)m = 2435.2348 (64)

12Total per year (kWh/year) 2435 (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 | 86.0311 | 75.9975 | 80.4973 | 70.1744 | 67.6233 | 60.4953 | 59.3723 | 61.9662 | 62.9104 | 70.6792 | 75.8057 | 85.0103 | (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 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | 131.2037 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 120.4521 | 133.3577 | 120.4521 | 124.4672 | 120.4521 | 124.4672 | 120.4521 | 120.4521 | 124.4672 | 120.4521 | 124.4672 | 120.4521 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 238.8568 | 241.3354 | 235.0894 | 221.7925 | 205.0076 | 189.2321 | 178.6931 | 176.2145 | 182.4605 | 195.7574 | 212.5423 | 228.3178 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | 36.1204 | (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) | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | -104.9630 | (71) |
| Water heating gains (Table 5) | 115.6331 | 113.0915 | 108.1953 | 97.4645 | 90.8916 | 84.0212 | 79.8015 | 83.2879 | 87.3755 | 94.9989 | 105.2856 | 114.2611 | (72) |
| Total internal gains | 540.3032 | 553.1457 | 529.0980 | 509.0854 | 481.7124 | 460.0816 | 441.3078 | 442.3156 | 456.6643 | 476.5695 | 507.6563 | 528.3922 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| South | 3.1600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 45.1502 | (78) |
| Southwest | 12.4700 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 140.2211 | (79) |
| Northwest | 4.7400 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 16.3445 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 201.7158 | 346.0625 | 480.9363 | 609.8232 | 696.8087 | 698.1011 | 670.3885 | 604.3398 | 525.2927 | 384.3926 | 242.0366 | 172.3617 | (83) |
| Total gains | 742.0190 | 899.2082 | 1010.0344 | 1118.9085 | 1178.5211 | 1158.1828 | 1111.6963 | 1046.6555 | 981.9570 | 860.9621 | 749.6929 | 700.7539 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 15.6362 | 15.6695 | 15.7022 | 15.8578 | 15.8872 | 16.0258 | 16.0258 | 16.0517 | 15.9721 | 15.8872 | 15.8278 | 15.7661 | |
| alpha | 2.0424 | 2.0446 | 2.0468 | 2.0572 | 2.0591 | 2.0684 | 2.0684 | 2.0701 | 2.0648 | 2.0591 | 2.0552 | 2.0511 | |
| util living area | 0.9096 | 0.8712 | 0.8231 | 0.7444 | 0.6410 | 0.5128 | 0.3999 | 0.4336 | 0.5990 | 0.7764 | 0.8770 | 0.9181 | (86) |
| MIT | 17.7435 | 18.2044 | 18.8088 | 19.5536 | 20.1875 | 20.6452 | 20.8493 | 20.8163 | 20.4776 | 19.6399 | 18.5674 | 17.6605 | (87) |
| Th 2 | 19.8376 | 19.8398 | 19.8419 | 19.8519 | 19.8538 | 19.8625 | 19.8625 | 19.8641 | 19.8591 | 19.8538 | 19.8500 | 19.8460 | (88) |
| util rest of house | 0.8987 | 0.8562 | 0.8023 | 0.7134 | 0.5949 | 0.4452 | 0.3115 | 0.3449 | 0.5348 | 0.7422 | 0.8601 | 0.9081 | (89) |
| MIT 2 | 16.1072 | 16.6770 | 17.4222 | 18.3289 | 19.0727 | 19.5800 | 19.7745 | 19.7508 | 19.4153 | 18.4564 | 17.1441 | 16.0067 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3858 | (91) |
| MIT | 16.7385 | 17.2663 | 17.9573 | 18.8014 | 19.5029 | 19.9910 | 20.1892 | 20.1619 | 19.8252 | 18.9131 | 17.6932 | 16.6448 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.7385 | 17.2663 | 17.9573 | 18.8014 | 19.5029 | 19.9910 | 20.1892 | 20.1619 | 19.8252 | 18.9131 | 17.6932 | 16.6448 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8582 | 0.8128 | 0.7603 | 0.6804 | 0.5793 | 0.4533 | 0.3381 | 0.3694 | 0.5327 | 0.7086 | 0.8183 | 0.8691 | (94) |
| Useful gains | 636.8278 | 730.8995 | 767.9224 | 761.3497 | 682.7204 | 525.0602 | 375.8773 | 386.6803 | 523.0723 | 610.1184 | 613.4585 | 609.0112 | (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 | 1457.9609 | 1446.4183 | 1337.2992 | 1144.3643 | 900.1488 | 616.5363 | 410.4789 | 429.5342 | 656.9517 | 959.0070 | 1226.6429 | 1446.6858 | (97) |
| Space heating kWh | 610.9230 | 480.8287 | 423.6163 | 275.7705 | 161.7667 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 259.5731 | 441.4928 | 623.2299 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3277.2009 | |
| 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 | 610.9230 | 480.8287 | 423.6163 | 275.7705 | 161.7667 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 259.5731 | 441.4928 | 623.2299 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3277.2009 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 36.4620 | (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 | 610.9230 | 480.8287 | 423.6163 | 275.7705 | 161.7667 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 259.5731 | 441.4928 | 623.2299 | (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) | 661.1721 | 520.3773 | 458.4592 | 298.4529 | 175.0722 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 280.9233 | 477.8060 | 674.4912 | (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 | 240.1981 | 212.4030 | 225.8599 | 199.3722 | 193.7346 | 175.1049 | 173.3304 | 179.9983 | 181.7077 | 201.9505 | 213.8696 | 237.7056 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.2919 | 86.0755 | 85.7079 | 85.0767 | 83.9975 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.9203 | 85.8978 | 86.3467 | (217) |
| Fuel for water heating, kWh/month | 278.3554 | 246.7637 | 263.5229 | 234.3439 | 230.6433 | 218.0634 | 215.8536 | 224.1572 | 226.2860 | 237.8117 | 248.9813 | 275.2919 | (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 | 25.0276 | 20.0780 | 18.0781 | 13.2448 | 10.2306 | 8.3585 | 9.3327 | 12.1310 | 15.7570 | 20.6740 | 23.3513 | 25.7232 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -16.8614 | -25.4329 | -39.0778 | -47.0595 | -53.5203 | -50.9679 | -50.3358 | -46.1225 | -39.2171 | -30.4040 | -19.1137 | -14.3898 | (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 | -5.0722 | -10.9841 | -22.4359 | -34.6119 | -46.6861 | -47.2609 | -46.7180 | -39.1404 | -28.1417 | -16.0142 | -6.8670 | -3.9889 | (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 | 3546.7543 | (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 | 2900.0745 | (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) | 201.9869 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -740.4240 | (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 | 5994.3916 | (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 | 3546.7543 | 0.2100 | 744.8184 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2900.0745 | 0.2100 | 609.0156 | (264) |
| Space and water heating | | | 1353.8340 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 201.9869 | 0.1443 | 29.1529 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -432.5028 | 0.1332 | -57.6111 | |
| PV Unit electricity exported | -307.9213 | 0.1251 | -38.5252 | |
| Total | | | -96.1362 | (269) |
| Total CO2, kg/year | | | 1298.7800 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.4500 | (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 | 3546.7543 | 1.1300 | 4007.8323 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2900.0745 | 1.1300 | 3277.0842 | (278) |
| Space and water heating | | | 7284.9165 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 201.9869 | 1.5338 | 309.8142 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -432.5028 | 1.4922 | -645.3893 | |
| PV Unit electricity exported | -307.9213 | 0.4592 | -141.4020 | |
| Total | | | -786.7913 | (283) |
| Total Primary energy kWh/year | | | 6938.0402 | (286) |
| Target Primary Energy Rate (TPER) | | | 77.1900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F6 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F6 | **Prop Type Ref** | F6 |
| **Property** | F6 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 15.92 | **TER** | 15.36 |
| **Environmental** | 86 B | **% DER < TER** | | | -3.65 |
| **$CO_2$ Emissions (t/year)** | 1.39 | **DFEE** | 38.82 | **TFEE** | 48.70 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 20.30 |
| **% DPER < TPER** | -7.27 | **DPER** | 88.03 | **TPER** | 82.07 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 95.3800 | (1b) | x 2.5000 | (2b) = | 238.4500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.3800 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 238.4500 | (5) |

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## 2. Ventilation rate

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| | | 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) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1258 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3758 | (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) = | 0.3194 | (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 | 0.4073 | 0.3993 | 0.3913 | 0.3514 | 0.3434 | 0.3035 | 0.3035 | 0.2955 | 0.3194 | 0.3434 | 0.3594 | 0.3753 | (22b) |
| Effective ac | 0.5829 | 0.5797 | 0.5766 | 0.5617 | 0.5590 | 0.5460 | 0.5460 | 0.5437 | 0.5510 | 0.5590 | 0.5646 | 0.5704 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 22.8600 | 1.1450 | 26.1756 | | | (27) |
| External Wall | 97.4200 | 24.9600 | 72.4600 | 0.1500 | 10.8690 | 9.0000 | 652.1400 | (29a) |
| Communal Wall | 18.9000 | | 18.9000 | 0.1500 | 2.8350 | 9.0000 | 170.1000 | (29a) |
| External Roof | 95.3500 | | 95.3500 | 0.1000 | 9.5350 | 9.0000 | 858.1500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 211.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 51.5146 | | | (33) |
| Party Wall | | | 16.1500 | 0.0000 | 0.0000 | 20.0000 | 323.0000 | (32) |
| Party Floor | | | 95.3500 | | | 40.0000 | 3814.0000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6717.3900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 70.4277 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 10.5835 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 62.0981 (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 | 45.8708 | 45.6173 | 45.3689 | 44.2021 | 43.9838 | 42.9676 | 42.9676 | 42.7794 | 43.3590 | 43.9838 | 44.4255 | 44.8872 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 107.9688 | 107.7154 | 107.4670 | 106.3002 | 106.0819 | 105.0657 | 105.0657 | 104.8775 | 105.4571 | 106.0819 | 106.5235 | 106.9852 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 106.2992 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1320 | 1.1293 | 1.1267 | 1.1145 | 1.1122 | 1.1015 | 1.1015 | 1.0996 | 1.1057 | 1.1122 | 1.1168 | 1.1217 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1145 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6924 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 95.3744 | 93.9411 | 91.8525 | 87.8564 | 84.9074 | 81.6186 | 79.7493 | 81.8221 | 84.0942 | 87.6253 | 91.7073 | 95.0090 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29.9517 | 29.5068 | 28.8804 | 27.7255 | 26.8606 | 25.9017 | 25.3837 | 26.0057 | 26.6830 | 27.7091 | 28.8879 | 29.8504 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 42.2033 | 40.6687 | 39.1340 | 37.5993 | 36.0647 | 34.5300 | 34.5300 | 36.0647 | 37.5993 | 39.1340 | 40.6687 | 42.2033 (42c) |

Average daily hot water use (litres/day) 154.0686 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 167.5294 | 164.1166 | 159.8670 | 153.1812 | 147.8326 | 142.0503 | 139.6629 | 143.8924 | 148.3765 | 154.4684 | 161.2638 | 167.0627 | (44) |
| Energy conte | 265.3256 | 233.6999 | 245.7096 | 209.6974 | 199.0111 | 174.6674 | 168.9102 | 178.1689 | 182.9631 | 209.6122 | 229.7499 | 261.5799 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2559.0950 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 39.7988 | 35.0550 | 36.8564 | 31.4546 | 29.8517 | 26.2001 | 25.3365 | 26.7253 | 27.4445 | 31.4418 | 34.4625 | 39.2370 | (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 | | | | | | | | | | | | | |
| | 316.2845 | 279.7273 | 296.6685 | 259.0125 | 249.9700 | 223.9824 | 219.8691 | 229.1278 | 232.2781 | 260.5711 | 279.0649 | 312.5388 | (62) |
| WWHRS | -27.1296 | -23.9937 | -25.1248 | -20.8043 | -19.3889 | -16.5912 | -15.5516 | -16.5376 | -17.1659 | -20.2367 | -22.9257 | -26.6272 | (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 | | | | | | | | | | | | | |
| | 289.1549 | 255.7336 | 271.5437 | 238.2081 | 230.5812 | 207.3912 | 204.3175 | 212.5902 | 215.1122 | 240.3344 | 256.1392 | 285.9115 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2907.0178 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2907 | (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 | | | | | | | | | | | | | |
| | 100.9605 | 89.2121 | 94.4382 | 82.0531 | 78.9109 | 70.4057 | 68.9024 | 71.9809 | 73.1640 | 82.4358 | 88.7206 | 99.7150 | (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 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 125.4080 | 138.8445 | 125.4080 | 129.5882 | 125.4080 | 129.5882 | 125.4080 | 125.4080 | 129.5882 | 125.4080 | 129.5882 | 125.4080 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 248.6353 | 251.2154 | 244.7137 | 230.8724 | 213.4003 | 196.9790 | 186.0086 | 183.4285 | 189.9302 | 203.7714 | 221.2435 | 237.6649 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | (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) | | | | | | | | | | | | | |
| | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 135.6996 | 132.7560 | 126.9330 | 113.9627 | 106.0631 | 97.7856 | 92.6107 | 96.7485 | 101.6166 | 110.8008 | 123.2231 | 134.0256 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 576.1295 | 589.2026 | 563.4413 | 540.8100 | 511.2580 | 487.7396 | 467.4139 | 468.9716 | 484.5217 | 506.3668 | 540.4415 | 563.4851 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 6.1000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 21.0341 | (75) |
| Southeast | 3.3800 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 38.0070 | (77) |
| Northwest | 13.3800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 46.1371 | (81) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 105.1782 | 201.4689 | 334.9221 | 514.3194 | 666.7486 | 701.8089 | 660.0217 | 540.2054 | 396.0851 | 238.6450 | 130.0424 | 87.3815 (83) |
| Total gains | 681.3077 | 790.6715 | 898.3634 | 1055.1294 | 1178.0067 | 1189.5485 | 1127.4356 | 1009.1770 | 880.6068 | 745.0119 | 670.4839 | 650.8665 (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 | 17.2822 | 17.3229 | 17.3629 | 17.5535 | 17.5896 | 17.7598 | 17.7598 | 17.7916 | 17.6938 | 17.5896 | 17.5167 | 17.4411 | |
| alpha | 2.1521 | 2.1549 | 2.1575 | 2.1702 | 2.1726 | 2.1840 | 2.1840 | 2.1861 | 2.1796 | 2.1726 | 2.1678 | 2.1627 | |
| util living area | | | | | | | | | | | | | |
| | 0.9197 | 0.8907 | 0.8434 | 0.7493 | 0.6223 | 0.4808 | 0.3734 | 0.4231 | 0.6181 | 0.8057 | 0.8931 | 0.9261 | (86) |
| MIT | 17.9169 | 18.2979 | 18.8974 | 19.6915 | 20.3302 | 20.7334 | 20.8903 | 20.8527 | 20.5141 | 19.6708 | 18.6740 | 17.8558 | (87) |
| Th 2 | 19.9748 | 19.9770 | 19.9791 | 19.9890 | 19.9909 | 19.9996 | 19.9996 | 20.0012 | 19.9962 | 19.9909 | 19.9871 | 19.9832 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9106 | 0.8787 | 0.8260 | 0.7216 | 0.5807 | 0.4222 | 0.2988 | 0.3457 | 0.5609 | 0.7773 | 0.8793 | 0.9178 | (89) |
| MIT 2 | 17.1657 | 17.5390 | 18.1235 | 18.8870 | 19.4743 | 19.8269 | 19.9456 | 19.9246 | 19.6573 | 18.8886 | 17.9214 | 17.1111 | (90) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Living area fraction | | | | | | | | | | | fLA = Living area / (4) = | 0.3710 | (91) |
| MIT | 17.4444 | 17.8206 | 18.4107 | 19.1855 | 19.7919 | 20.1632 | 20.2961 | 20.2690 | 19.9752 | 19.1788 | 18.2007 | 17.3874 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.2944 | 17.6706 | 18.2607 | 19.0355 | 19.6419 | 20.0132 | 20.1461 | 20.1190 | 19.8252 | 19.0288 | 18.0507 | 17.2374 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8789 | 0.8438 | 0.7901 | 0.6917 | 0.5650 | 0.4231 | 0.3102 | 0.3553 | 0.5501 | 0.7447 | 0.8452 | 0.8873 | (94) |
| Useful gains | 598.8003 | 667.2052 | 709.8013 | 729.8203 | 665.5830 | 503.2564 | 349.6771 | 358.5647 | 484.4522 | 554.8106 | 566.6898 | 577.5095 | (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 | 1402.9926 | 1375.5888 | 1263.8851 | 1077.4075 | 842.4918 | 568.7423 | 372.5711 | 390.0342 | 603.7637 | 894.1421 | 1166.5032 | 1394.8098 | (97) |
| Space heating kWh | 598.3190 | 476.0338 | 412.2383 | 250.2628 | 131.6201 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 252.4626 | 431.8657 | 608.0714 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3160.8737 | |
| 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 | 598.3190 | 476.0338 | 412.2383 | 250.2628 | 131.6201 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 252.4626 | 431.8657 | 608.0714 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3160.8737 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.1398 | (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 %) | | | | | | | | | | | | 88.9000 | (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 | 598.3190 | 476.0338 | 412.2383 | 250.2628 | 131.6201 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 252.4626 | 431.8657 | 608.0714 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 673.0248 | 535.4711 | 463.7101 | 281.5105 | 148.0541 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 283.9849 | 485.7882 | 683.9948 | (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 | 289.1549 | 255.7336 | 271.5437 | 238.2081 | 230.5812 | 207.3912 | 204.3175 | 212.5902 | 215.1122 | 240.3344 | 256.1392 | 285.9115 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.9025 | 85.6927 | 85.2732 | 84.4874 | 83.2257 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.4871 | 85.4913 | 85.9558 | (217) |
| Fuel for water heating, kWh/month | 336.6084 | 298.4311 | 318.4395 | 281.9451 | 277.0553 | 258.2705 | 254.4427 | 264.7449 | 267.8857 | 284.4627 | 299.6085 | 332.6261 | (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 | 26.0573 | 20.9041 | 18.8219 | 13.7897 | 10.6516 | 8.7024 | 9.7167 | 12.6301 | 16.4053 | 21.5247 | 24.3120 | 26.7815 | (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) | | | | | | | | | | | | | |
| (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 | 3555.5385 | (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 | 3474.5206 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 210.2973 | (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 | 7326.3564 | (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 | 3555.5385 | 0.2100 | 746.6631 | (261) |

| | | | | |
|---|---|---|---|---|
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3474.5206 | 0.2100 | 729.6493 | (264) |
| Space and water heating | | | 1476.3124 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 210.2973 | 0.1443 | 30.3524 | (268) |
| Total CO2, kg/year | | | 1518.5941 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.9200 | (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 | 3555.5385 | 1.1300 | 4017.7585 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3474.5206 | 1.1300 | 3926.2083 | (278) |
| Space and water heating | | | 7943.9668 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 210.2973 | 1.5338 | 322.5610 | (282) |
| Total Primary energy kWh/year | | | 8396.6286 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 88.0300 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 95.3800 | (1b) | x 2.5000 | (2b) = | 238.4500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.3800 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 238.4500 | (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) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1258 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3758 (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) = | 0.3194 (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 | 0.4073 | 0.3993 | 0.3913 | 0.3514 | 0.3434 | 0.3035 | 0.3035 | 0.2955 | 0.3194 | 0.3434 | 0.3594 | 0.3753 | (22b) |
| Effective ac | 0.5829 | 0.5797 | 0.5766 | 0.5617 | 0.5590 | 0.5460 | 0.5460 | 0.5437 | 0.5510 | 0.5590 | 0.5646 | 0.5704 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 21.7500 | 1.1450 | 24.9046 | | | (27) |
| External Wall | 97.4200 | 23.8500 | 73.5700 | 0.1800 | 13.2426 | | | (29a) |
| Communal Wall | 18.9000 | | 18.9000 | 0.1800 | 3.4020 | | | (29a) |
| External Roof | 95.3500 | | 95.3500 | 0.1100 | 10.4885 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 211.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 54.1377 | | | (33) |
| Party Wall | | | 16.1500 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 70.4277 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 13.7700 | 0.0500 | 0.6885 |
| E3 Sill | 8.7500 | 0.0500 | 0.4375 |
| E4 Jamb | 42.2300 | 0.0500 | 2.1115 |
| E7 Party floor between dwellings (in blocks of flats) | 37.4000 | 0.0700 | 2.6180 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 9.1200 | 0.0200 | 0.1824 |
| E14 Flat roof | 7.5600 | 0.0800 | 0.6048 |
| E15 Flat roof with parapet | 38.9600 | 0.5600 | 21.8176 |
| E16 Corner (normal) | 17.5000 | 0.0900 | 1.5750 |

| | | | | |
|---|---|---|---|---|
| E18 Party wall between dwellings | 5.0000 | 0.0600 | 0.3000 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 6.4600 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 6.4600 | 0.1200 | 0.7752 | |
| E17 Corner (inverted - internal area greater than external area) | 7.5000 | -0.0900 | -0.6750 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.4355 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 84.5732 (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 | 45.8708 | 45.6173 | 45.3689 | 44.2021 | 43.9838 | 42.9676 | 42.9676 | 42.7794 | 43.3590 | 43.9838 | 44.4255 | 44.8872 | (38) |
| Heat transfer coeff | 130.4440 | 130.1905 | 129.9421 | 128.7753 | 128.5570 | 127.5408 | 127.5408 | 127.3526 | 127.9322 | 128.5570 | 128.9986 | 129.4603 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 128.7743 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3676 | 1.3650 | 1.3624 | 1.3501 | 1.3478 | 1.3372 | 1.3372 | 1.3352 | 1.3413 | 1.3478 | 1.3525 | 1.3573 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3501 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6924 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 69.3632 | 68.3208 | 66.8018 | 63.8956 | 61.7508 | 59.3590 | 57.9995 | 59.5069 | 61.1594 | 63.7275 | 66.6962 | 69.0975 | (42a) |
| Hot water usage for baths | 29.9517 | 29.5068 | 28.8804 | 27.7255 | 26.8606 | 25.9017 | 25.3837 | 26.0057 | 26.6830 | 27.7091 | 28.8879 | 29.8504 | (42b) |
| Hot water usage for other uses | 42.2033 | 40.6687 | 39.1340 | 37.5993 | 36.0647 | 34.5300 | 34.5300 | 36.0647 | 37.5993 | 39.1340 | 40.6687 | 42.2033 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 130.0871 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 141.5182 | 138.4963 | 134.8163 | 129.2203 | 124.6761 | 119.7906 | 117.9131 | 121.5773 | 125.4417 | 130.5706 | 136.2527 | 141.1512 | (44) |
| Energy conte | 224.1302 | 197.2169 | 207.2076 | 176.8962 | 167.8380 | 147.2966 | 142.6057 | 150.5381 | 154.6822 | 177.1831 | 194.1170 | 221.0086 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2160.7202 | |
| Distribution loss (46)m = 0.15 x (45)m | 33.6195 | 29.5825 | 31.0811 | 26.5344 | 25.1757 | 22.0945 | 21.3909 | 22.5807 | 23.2023 | 26.5775 | 29.1175 | 33.1513 | (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 | 275.0891 | 243.2443 | 258.1665 | 226.2113 | 218.7969 | 196.6116 | 193.5646 | 201.4970 | 203.9973 | 228.1420 | 243.4321 | 271.9676 | (62) |
| WWHRS | -31.7100 | -28.0446 | -29.3666 | -24.3167 | -22.6623 | -19.3923 | -18.1772 | -19.3296 | -20.0640 | -23.6533 | -26.7963 | -31.1227 | (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 | 243.3792 | 215.1998 | 228.7999 | 201.8945 | 196.1346 | 177.2193 | 175.3874 | 182.1674 | 183.9332 | 204.4887 | 216.6358 | 240.8448 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2466.0845 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2466 | (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 | 87.2630 | 77.0815 | 81.6363 | 71.1468 | 68.5459 | 61.3049 | 60.1561 | 62.7936 | 63.7606 | 71.6531 | 76.8727 | 86.2251 | (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 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 125.3824 | 138.8162 | 125.3824 | 129.5618 | 125.3824 | 129.5618 | 125.3824 | 125.3824 | 129.5618 | 125.3824 | 129.5618 | 125.3824 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 248.6353 | 251.2154 | 244.7137 | 230.8724 | 213.4003 | 196.9790 | 186.0086 | 183.4285 | 189.9302 | 203.7714 | 221.2435 | 237.6649 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | (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) | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | (71) |
| Water heating gains (Table 5) | 117.2890 | 114.7046 | 109.7261 | 98.8149 | 92.1315 | 85.1457 | 80.8550 | 84.4001 | 88.5564 | 96.3079 | 106.7676 | 115.8940 | (72) |
| Total internal gains | 557.6934 | 571.1228 | 546.2089 | 525.6359 | 497.3009 | 475.0732 | 455.6327 | 456.5976 | 471.4350 | 491.8484 | 523.9596 | 545.3279 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 5.8000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 19.9996 | (75) |
| Southeast | 3.2200 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 36.2078 | (77) |
| Northwest | 12.7300 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 43.8958 | (81) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 100.1032 | 191.7363 | 318.7153 | 489.3941 | 634.4085 | 667.7577 | 628.0021 | 514.0149 | 376.9060 | 227.1092 | 123.7656 | 83.1666 | (83) |
| Total gains | 657.7966 | 762.8591 | 864.9243 | 1015.0299 | 1131.7095 | 1142.8309 | 1083.6348 | 970.6126 | 848.3411 | 718.9576 | 647.7252 | 628.4945 | (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 | 14.3045 | 14.3324 | 14.3598 | 14.4899 | 14.5145 | 14.6302 | 14.6302 | 14.6518 | 14.5854 | 14.5145 | 14.4648 | 14.4132 | |
| alpha | 1.9536 | 1.9555 | 1.9573 | 1.9660 | 1.9676 | 1.9753 | 1.9753 | 1.9768 | 1.9724 | 1.9676 | 1.9643 | 1.9609 | |
| util living area | 0.9307 | 0.9072 | 0.8691 | 0.7914 | 0.6811 | 0.5483 | 0.4386 | 0.4901 | 0.6767 | 0.8379 | 0.9091 | 0.9361 | (86) |
| MIT | 17.2750 | 17.6572 | 18.3008 | 19.1918 | 19.9815 | 20.5433 | 20.7932 | 20.7347 | 20.2579 | 19.2388 | 18.1183 | 17.2106 | (87) |
| Th 2 | 19.7882 | 19.7903 | 19.7923 | 19.8018 | 19.8035 | 19.8118 | 19.8118 | 19.8134 | 19.8086 | 19.8035 | 19.8000 | 19.7962 | (88) |
| util rest of house | 0.9218 | 0.8955 | 0.8519 | 0.7630 | 0.6352 | 0.4774 | 0.3416 | 0.3922 | 0.6128 | 0.8093 | 0.8956 | 0.9279 | (89) |
| MIT 2 | 15.5320 | 16.0066 | 16.8039 | 17.8922 | 18.8229 | 19.4483 | 19.6913 | 19.6484 | 19.1676 | 17.9771 | 16.5927 | 15.4535 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3710 | (91) |
| MIT | 16.1787 | 16.6190 | 17.3593 | 18.3744 | 19.2528 | 19.8546 | 20.1002 | 20.0515 | 19.5722 | 18.4452 | 17.1588 | 16.1055 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.1787 | 16.6190 | 17.3593 | 18.3744 | 19.2528 | 19.8546 | 20.1002 | 20.0515 | 19.5722 | 18.4452 | 17.1588 | 16.1055 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8828 | 0.8520 | 0.8059 | 0.7217 | 0.6112 | 0.4802 | 0.3667 | 0.4135 | 0.5982 | 0.7672 | 0.8534 | 0.8903 | (94) |
| Useful gains | 580.6714 | 649.9580 | 697.0077 | 732.5425 | 691.6915 | 548.7958 | 397.3754 | 401.3410 | 507.5168 | 551.6031 | 552.7531 | 559.5518 | (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 | 1549.5065 | 1525.7038 | 1411.0821 | 1220.0675 | 970.9648 | 670.1760 | 446.4159 | 465.0248 | 700.0669 | 1008.5606 | 1297.5679 | 1541.2867 | (97) |
| Space heating kWh | 720.8133 | 588.5012 | 531.2714 | 351.0180 | 207.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 339.9764 | 536.2667 | 730.4108 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4006.0371 | |
| 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 | 720.8133 | 588.5012 | 531.2714 | 351.0180 | 207.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 339.9764 | 536.2667 | 730.4108 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4006.0371 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 42.0008 | (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 | 720.8133 | 588.5012 | 531.2714 | 351.0180 | 207.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 339.9764 | 536.2667 | 730.4108 | (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) | 780.1010 | 636.9060 | 574.9690 | 379.8897 | 224.8694 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 367.9398 | 580.3752 | 790.4878 | (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 | 243.3792 | 215.1998 | 228.7999 | 201.8945 | 196.1346 | 177.2193 | 175.3874 | 182.1674 | 183.9332 | 204.4887 | 216.6358 | 240.8448 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.5600 | 86.4217 | 86.1234 | 85.5543 | 84.5053 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.4624 | 86.2424 | 86.6001 | (217) |
| Fuel for water heating, kWh/month | 281.1683 | 249.0112 | 265.6650 | 235.9842 | 232.0974 | 220.6965 | 218.4152 | 226.8585 | 229.0576 | 239.2733 | 251.1941 | 278.1114 | (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 | 26.0520 | 20.8999 | 18.8180 | 13.7869 | 10.6494 | 8.7006 | 9.7147 | 12.6276 | 16.4020 | 21.5203 | 24.3071 | 26.7761 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -17.8403 | -26.8803 | -41.2566 | -49.6260 | -56.3857 | -53.6742 | -53.0053 | -48.5926 | -41.3550 | -32.1073 | -20.2124 | -15.2281 | (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 | -5.4356 | -11.7652 | -24.0213 | -37.0431 | -49.9526 | -50.5655 | -49.9875 | -41.8877 | -30.1257 | -17.1513 | -7.3581 | -4.2752 | (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 | 4335.5379 | (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 | 2927.5328 | (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) | 210.2545 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -785.7326 | (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 | 6773.5926 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4335.5379 | 0.2100 | 910.4630 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2927.5328 | 0.2100 | 614.7819 | (264) |
| Space and water heating | | | 1525.2449 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 210.2545 | 0.1443 | 30.3462 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -456.1638 | 0.1332 | -60.7735 | |
| PV Unit electricity exported | -329.5688 | 0.1251 | -41.2368 | |
| Total | | | -102.0103 | (269) |
| Total CO2, kg/year | | | 1465.5100 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.3600 | (273) |

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4335.5379 | 1.1300 | 4899.1579 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2927.5328 | 1.1300 | 3308.1120 | (278) |
| Space and water heating | | | 8207.2699 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 210.2545 | 1.5338 | 322.4953 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -456.1638 | 1.4923 | -680.7370 | |
| PV Unit electricity exported | -329.5688 | 0.4593 | -151.3547 | |
| Total | | | -832.0917 | (283) |
| Total Primary energy kWh/year | | | 7827.7744 | (286) |
| Target Primary Energy Rate (TPER) | | | 82.0700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Property Reference | F6 | Issued on Date | 02/10/2024 |
| Assessment Reference | F6 | Prop Type Ref | F6 |
| Property | F6 | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 84 B | DER | 15.92 | TER | 15.36 |
| Environmental | 86 B | % DER < TER | | | -3.65 |
| $CO_2$ Emissions (t/year) | 1.39 | DFEE | 38.82 | TFEE | 48.70 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 20.30 |
| % DPER < TPER | -7.27 | DPER | 88.03 | TPER | 82.07 |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Matthew Stainrod | Assessor ID | AU83-0001 |
| Client | | | |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 95.3800 | (1b) | x 2.5000 | (2b) = | 238.4500 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.3800 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 238.4500 | (5) |

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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) |

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1258 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3758 | (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) = | 0.3194 | (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 | 0.4073 | 0.3993 | 0.3913 | 0.3514 | 0.3434 | 0.3035 | 0.3035 | 0.2955 | 0.3194 | 0.3434 | 0.3594 | 0.3753 | (22b) |

| | |
|---|---|
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 0.0000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5829 | 0.5797 | 0.5766 | 0.5617 | 0.5590 | 0.5460 | 0.5460 | 0.5437 | 0.5510 | 0.5590 | 0.5646 | 0.5704 | (25) |

---

3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 22.8600 | 1.1450 | 26.1756 | | | (27) |
| External Wall | 97.4200 | 24.9600 | 72.4600 | 0.1500 | 10.8690 | 9.0000 | 652.1400 | (29a) |
| Communal Wall | 18.9000 | | 18.9000 | 0.1500 | 2.8350 | 9.0000 | 170.1000 | (29a) |
| External Roof | 95.3500 | | 95.3500 | 0.1000 | 9.5350 | 9.0000 | 858.1500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 211.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 51.5146 | | | (33) |
| Party Wall | | | 16.1500 | 0.0000 | 0.0000 | 20.0000 | 323.0000 | (32) |
| Party Floor | | | 95.3500 | | | 40.0000 | 3814.0000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6717.3900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 70.4277 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 10.5835 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 62.0981 (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 | 45.8708 | 45.6173 | 45.3689 | 44.2021 | 43.9838 | 42.9676 | 42.9676 | 42.7794 | 43.3590 | 43.9838 | 44.4255 | 44.8872 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 107.9688 | 107.7154 | 107.4670 | 106.3002 | 106.0819 | 105.0657 | 105.0657 | 104.8775 | 105.4571 | 106.0819 | 106.5235 | 106.9852 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 106.2992 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1320 | 1.1293 | 1.1267 | 1.1145 | 1.1122 | 1.1015 | 1.1015 | 1.0996 | 1.1057 | 1.1122 | 1.1168 | 1.1217 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1145 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.6924 | (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 | | | | | | | | | | | | | |
| | 29.9517 | 29.5068 | 28.8804 | 27.7255 | 26.8606 | 25.9017 | 25.3837 | 26.0057 | 26.6830 | 27.7091 | 28.8879 | 29.8504 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 42.2033 | 40.6687 | 39.1340 | 37.5993 | 36.0647 | 34.5300 | 34.5300 | 36.0647 | 37.5993 | 39.1340 | 40.6687 | 42.2033 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 66.1366 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 72.1550 | 70.1755 | 68.0144 | 65.3248 | 62.9253 | 60.4317 | 59.9137 | 62.0704 | 64.2823 | 66.8431 | 69.5565 | 72.0537 | (44) |
| Energy conte | 114.2759 | 99.9290 | 104.5356 | 89.4264 | 84.7095 | 74.3078 | 72.4604 | 76.8561 | 79.2665 | 90.7054 | 99.0960 | 112.8187 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1098.3873 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 97.1345 | 84.9396 | 88.8553 | 76.0124 | 72.0031 | 63.1616 | 61.5913 | 65.3277 | 67.3765 | 77.0996 | 84.2316 | 95.8959 | (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 | | | | | | | | | | | | | |
| | 97.1345 | 84.9396 | 88.8553 | 76.0124 | 72.0031 | 63.1616 | 61.5913 | 65.3277 | 67.3765 | 77.0996 | 84.2316 | 95.8959 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 933.6292 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 934 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 55.5484 | 49.4941 | 54.0456 | 51.5751 | 52.5429 | 50.1208 | 51.7915 | 52.5429 | 51.5751 | 54.0456 | 53.0293 | 55.5484 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 631.8595 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 38.1707 | 33.6084 | 35.7252 | 31.8969 | 31.1365 | 28.3206 | 28.3457 | 29.4676 | 29.7379 | 32.7863 | 34.3152 | 37.8611 | (65) |

---

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 125.4080 | 138.8445 | 125.4080 | 129.5882 | 125.4080 | 129.5882 | 125.4080 | 125.4080 | 129.5882 | 125.4080 | 129.5882 | 125.4080 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 248.6353 | 251.2154 | 244.7137 | 230.8724 | 213.4003 | 196.9790 | 186.0086 | 183.4285 | 189.9302 | 203.7714 | 221.2435 | 237.6649 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | (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) | | | | | | | | | | | | | |
| | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 51.3047 | 50.0125 | 48.0178 | 44.3012 | 41.8501 | 39.3342 | 38.0991 | 39.6070 | 41.3026 | 44.0676 | 47.6601 | 50.8885 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 488.7347 | 503.4591 | 481.5261 | 468.1485 | 444.0451 | 429.2881 | 412.9023 | 411.8302 | 424.2077 | 436.6337 | 461.8785 | 477.3480 | (73) |

---

## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 6.1000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 21.0341 | (75) |
| Southeast | 3.3800 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 38.0070 | (77) |
| Northwest | 13.3800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 46.1371 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 105.1782 | 201.4689 | 334.9221 | 514.3194 | 666.7486 | 701.8089 | 660.0217 | 540.2054 | 396.0851 | 238.6450 | 130.0424 | 87.3815 | (83) |
| Total gains | 593.9129 | 704.9280 | 816.4482 | 982.4679 | 1110.7937 | 1131.0970 | 1072.9239 | 952.0355 | 820.2928 | 675.2787 | 591.9209 | 564.7295 | (84) |

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## 7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 17.2822 | 17.3229 | 17.3629 | 17.5535 | 17.5896 | 17.7598 | 17.7598 | 17.7916 | 17.6938 | 17.5896 | 17.5167 | 17.4411 | |
| alpha | 2.1521 | 2.1549 | 2.1575 | 2.1702 | 2.1726 | 2.1840 | 2.1840 | 2.1861 | 2.1796 | 2.1726 | 2.1678 | 2.1627 | |
| util living area | | | | | | | | | | | | | |
| | 0.9366 | 0.9094 | 0.8643 | 0.7708 | 0.6434 | 0.4988 | 0.3890 | 0.4429 | 0.6436 | 0.8308 | 0.9130 | 0.9424 | (86) |
| MIT | 17.7328 | 18.1321 | 18.7608 | 19.6036 | 20.2814 | 20.7126 | 20.8808 | 20.8384 | 20.4706 | 19.5671 | 18.5201 | 17.6701 | (87) |
| Th 2 | 19.9748 | 19.9770 | 19.9791 | 19.9890 | 19.9909 | 19.9996 | 19.9996 | 20.0012 | 19.9962 | 19.9909 | 19.9871 | 19.9832 | (88) |
| util rest of house | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.9292 | 0.8990 | 0.8486 | 0.7443 | 0.6021 | 0.4392 | 0.3122 | 0.3632 | 0.5868 | 0.8047 | 0.9013 | 0.9357 | (89) |
| MIT 2 | 16.9861 | 17.3790 | 17.9942 | 18.8076 | 19.4339 | 19.8124 | 19.9405 | 19.9165 | 19.6239 | 18.7943 | 17.7735 | 16.9296 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3710 | (91) |
| MIT | 17.2631 | 17.6585 | 18.2786 | 19.1030 | 19.7484 | 20.1465 | 20.2894 | 20.2586 | 19.9381 | 19.0810 | 18.0505 | 17.2044 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.2631 | 17.6585 | 18.2786 | 19.1030 | 19.7484 | 20.1465 | 20.2894 | 20.2586 | 19.9381 | 19.0810 | 18.0505 | 17.2044 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9025 | 0.8684 | 0.8161 | 0.7177 | 0.5913 | 0.4484 | 0.3353 | 0.3848 | 0.5832 | 0.7762 | 0.8719 | 0.9103 | (94) |
| Useful gains | 535.9935 | 612.1761 | 666.3208 | 705.1173 | 656.7749 | 507.2272 | 359.7425 | 366.3143 | 478.3625 | 524.1678 | 516.0796 | 514.0703 | (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 | | | | | | | | | | | | | |
| | 1399.6138 | 1374.2834 | 1265.8160 | 1084.5793 | 853.7855 | 582.7418 | 387.6289 | 404.6771 | 615.6701 | 899.6831 | 1166.4875 | 1391.2761 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 642.5335 | 512.1362 | 446.0244 | 273.2127 | 146.5759 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 279.3834 | 468.2937 | 652.6411 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3420.8007 | |
| 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 | | | | | | | | | | | | | |
| | 642.5335 | 512.1362 | 446.0244 | 273.2127 | 146.5759 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 279.3834 | 468.2937 | 652.6411 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3420.8007 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.8650 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 987.6172 | 777.4859 | 797.0688 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.7675 | 0.8192 | 0.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 758.0271 | 636.9323 | 621.1456 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1272.2975 | 1206.7301 | 1067.8972 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 370.2747 | 423.9296 | 332.3832 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.5687 | 105.9824 | 83.0958 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 281.6469 | (107) |
| Energy for space heating | | | | | | | | | | | | 35.8650 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.9529 | (108) |
| Total | | | | | | | | | | | | 38.8179 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 38.8 | (109) |

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

## 1. Overall dwelling characteristics

| | | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 95.3800 | (1b) | x 2.5000 | (2b) = | 238.4500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.3800 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 238.4500 | (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) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1258 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3758 | (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) = | 0.3194 | (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 | | | | | | | | | | | | | |
| | 0.4073 | 0.3993 | 0.3913 | 0.3514 | 0.3434 | 0.3035 | 0.3035 | 0.2955 | 0.3194 | 0.3434 | 0.3594 | 0.3753 | (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | | | | | | | | | | | 0.0000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | | | | | | | | | | | 0.0000 | (23c) |
| Effective ac | 0.5829 | 0.5797 | 0.5766 | 0.5617 | 0.5590 | 0.5460 | 0.5460 | 0.5437 | 0.5510 | 0.5590 | 0.5646 | 0.5704 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 21.7500 | 1.1450 | 24.9046 | | | (27) |
| External Wall | 97.4200 | 23.8500 | 73.5700 | 0.1800 | 13.2426 | | | (29a) |
| Communal Wall | 18.9000 | | 18.9000 | 0.1800 | 3.4020 | | | (29a) |
| External Roof | 95.3500 | | 95.3500 | 0.1100 | 10.4885 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 211.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 54.1377 | | | (33) |
| Party Wall | | | 16.1500 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 70.4277 | (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 13.7700 | 0.0500 | 0.6885 |
| E3 | Sill | 8.7500 | 0.0500 | 0.4375 |
| E4 | Jamb | 42.2300 | 0.0500 | 2.1115 |
| E7 | Party floor between dwellings (in blocks of flats) | 37.4000 | 0.0700 | 2.6180 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 9.1200 | 0.0200 | 0.1824 |
| E14 | Flat roof | 7.5600 | 0.0800 | 0.6048 |
| E15 | Flat roof with parapet | 38.9600 | 0.5600 | 21.8176 |
| E16 | Corner (normal) | 17.5000 | 0.0900 | 1.5750 |
| E18 | Party wall between dwellings | 5.0000 | 0.0600 | 0.3000 |
| P3 | Party wall - Intermediate floor between dwellings (in blocks of flats) | 6.4600 | 0.0000 | 0.0000 |
| P4 | Party wall - Roof (insulation at ceiling level) | 6.4600 | 0.1200 | 0.7752 |
| E17 | Corner (inverted - internal area greater than external area) | 7.5000 | -0.0900 | -0.6750 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 30.4355 | (36) |
| Point Thermal bridges (36a) = | 0.0000 | |
| Total fabric heat loss (33) + (36) + (36a) = | 84.5732 | (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 | 45.8708 | 45.6173 | 45.3689 | 44.2021 | 43.9838 | 42.9676 | 42.9676 | 42.7794 | 43.3590 | 43.9838 | 44.4255 | 44.8872 | (38) |
| Heat transfer coeff | 130.4440 | 130.1905 | 129.9421 | 128.7753 | 128.5570 | 127.5408 | 127.5408 | 127.3526 | 127.9322 | 128.5570 | 128.9986 | 129.4603 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 128.7743 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3676 | 1.3650 | 1.3624 | 1.3501 | 1.3478 | 1.3372 | 1.3372 | 1.3352 | 1.3413 | 1.3478 | 1.3525 | 1.3573 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3501 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.6924 | (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | | | | | | | | | | | | |
| | 29.9517 | 29.5068 | 28.8804 | 27.7255 | 26.8606 | 25.9017 | 25.3837 | 26.0057 | 26.6830 | 27.7091 | 28.8879 | 29.8504 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 42.2033 | 40.6687 | 39.1340 | 37.5993 | 36.0647 | 34.5300 | 34.5300 | 36.0647 | 37.5993 | 39.1340 | 40.6687 | 42.2033 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 66.1366 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 72.1550 | 70.1755 | 68.0144 | 65.3248 | 62.9253 | 60.4317 | 59.9137 | 62.0704 | 64.2823 | 66.8431 | 69.5565 | 72.0537 | (44) |
| Energy conte | 114.2759 | 99.9290 | 104.5356 | 89.4264 | 84.7095 | 74.3078 | 72.4604 | 76.8561 | 79.2665 | 90.7054 | 99.0960 | 112.8187 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1098.3873 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 97.1345 | 84.9396 | 88.8553 | 76.0124 | 72.0031 | 63.1616 | 61.5913 | 65.3277 | 67.3765 | 77.0996 | 84.2316 | 95.8959 | (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 | | | | | | | | | | | | | |
| | 97.1345 | 84.9396 | 88.8553 | 76.0124 | 72.0031 | 63.1616 | 61.5913 | 65.3277 | 67.3765 | 77.0996 | 84.2316 | 95.8959 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 933.6292 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 934 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 55.5484 | 49.4941 | 54.0456 | 51.5751 | 52.5429 | 50.1208 | 51.7915 | 52.5429 | 51.5751 | 54.0456 | 53.0293 | 55.5484 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 631.8595 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 38.1707 | 33.6084 | 35.7252 | 31.8969 | 31.1365 | 28.3206 | 28.3457 | 29.4676 | 29.7379 | 32.7863 | 34.3152 | 37.8611 | (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 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 125.3824 | 138.8162 | 125.3824 | 129.5618 | 125.3824 | 129.5618 | 125.3824 | 125.3824 | 129.5618 | 125.3824 | 129.5618 | 125.3824 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 248.6353 | 251.2154 | 244.7137 | 230.8724 | 213.4003 | 196.9790 | 186.0086 | 183.4285 | 189.9302 | 203.7714 | 221.2435 | 237.6649 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | (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) | | | | | | | | | | | | | |
| | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 51.3047 | 50.0125 | 48.0178 | 44.3012 | 41.8501 | 39.3342 | 38.0991 | 39.6070 | 41.3026 | 44.0676 | 47.6601 | 50.8885 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 488.7091 | 503.4308 | 481.5006 | 468.1221 | 444.0195 | 429.2617 | 412.8767 | 411.8046 | 424.1813 | 436.6081 | 461.8521 | 477.3225 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 5.8000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 19.9996 | (75) |
| Southeast | 3.2200 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 36.2078 | (77) |
| Northwest | 12.7300 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 43.8958 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 100.1032 | 191.7363 | 318.7153 | 489.3941 | 634.4085 | 667.7577 | 628.0021 | 514.0149 | 376.9060 | 227.1092 | 123.7656 | 83.1666 | (83) |
| Total gains | 588.8124 | 695.1671 | 800.2159 | 957.5162 | 1078.4281 | 1097.0194 | 1040.8788 | 925.8195 | 801.0873 | 663.7173 | 585.6177 | 560.4890 | (84) |

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 14.3045 | 14.3324 | 14.3598 | 14.4899 | 14.5145 | 14.6302 | 14.6302 | 14.6518 | 14.5854 | 14.5145 | 14.4648 | 14.4132 | |
| alpha | 1.9536 | 1.9555 | 1.9573 | 1.9660 | 1.9676 | 1.9753 | 1.9753 | 1.9768 | 1.9724 | 1.9676 | 1.9643 | 1.9609 | |
| util living area | 0.9421 | 0.9197 | 0.8831 | 0.8063 | 0.6966 | 0.5625 | 0.4519 | 0.5064 | 0.6952 | 0.8549 | 0.9224 | 0.9471 | (86) |
| MIT | 17.1384 | 17.5317 | 18.1935 | 19.1170 | 19.9346 | 20.5205 | 20.7814 | 20.7180 | 20.2168 | 19.1549 | 18.0018 | 17.0733 | (87) |
| Th 2 | 19.7882 | 19.7903 | 19.7923 | 19.8018 | 19.8035 | 19.8118 | 19.8118 | 19.8134 | 19.8086 | 19.8035 | 19.8000 | 19.7962 | (88) |
| util rest of house | 0.9346 | 0.9093 | 0.8673 | 0.7792 | 0.6515 | 0.4914 | 0.3532 | 0.4071 | 0.6325 | 0.8284 | 0.9106 | 0.9401 | (89) |
| MIT 2 | 16.2919 | 16.6797 | 17.3298 | 18.2261 | 18.9904 | 19.5092 | 19.7107 | 19.6740 | 19.2710 | 18.2850 | 17.1556 | 16.2325 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3710 | (91) |
| MIT | 16.6060 | 16.9958 | 17.6503 | 18.5567 | 19.3407 | 19.8844 | 20.1080 | 20.0614 | 19.6219 | 18.6078 | 17.4696 | 16.5445 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.6060 | 16.9958 | 17.6503 | 18.5567 | 19.3407 | 19.8844 | 20.1080 | 20.0614 | 19.6219 | 18.6078 | 17.4696 | 16.5445 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9059 | 0.8761 | 0.8307 | 0.7449 | 0.6316 | 0.4961 | 0.3795 | 0.4296 | 0.6211 | 0.7943 | 0.8785 | 0.9129 | (94) |
| Useful gains | 533.3962 | 609.0094 | 664.7184 | 713.2819 | 681.1881 | 544.2428 | 395.0413 | 397.7366 | 497.5615 | 527.1854 | 514.4804 | 511.6588 | (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 | 1605.2412 | 1574.7633 | 1448.8879 | 1243.5398 | 982.2711 | 673.9798 | 447.4117 | 466.2837 | 706.4298 | 1029.4548 | 1337.6635 | 1598.1167 | (97) |
| Space heating kWh | 797.4527 | 648.9866 | 583.4221 | 381.7857 | 224.0058 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 373.6884 | 592.6919 | 808.3247 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4410.3579 | |
| 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 | 797.4527 | 648.9866 | 583.4221 | 381.7857 | 224.0058 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 373.6884 | 592.6919 | 808.3247 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4410.3579 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 46.2399 | (99) |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ext. temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | |
| Heat loss rate W | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1198.8832 | 943.8017 | 967.8796 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.6730 | 0.7320 | 0.6868 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 806.8970 | 690.9030 | 664.7240 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1232.4952 | 1169.3022 | 1037.2818 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 306.4307 | 355.9290 | 277.1830 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Cooled fraction | | | | | | | | | | fC = cooled area / (4) = | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500 | (106) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 76.6077 | 88.9822 | 69.2958 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 234.8857 | (107) |
| Energy for space heating | | | | | | | | | | | | 46.2399 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.4626 | (108) |
| Total | | | | | | | | | | | | 48.7025 | (109) |
| Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 48.7 | (109) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | F6 | **Issued on Date** | 02/10/2024 |
| **Assessment Reference** | F6 | **Prop Type Ref** | F6 |
| **Property** | F6 | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 15.92 | **TER** | 15.36 |
| **Environmental** | 86 B | **% DER < TER** | | | -3.65 |
| **$CO_2$ Emissions (t/year)** | 1.39 | **DFEE** | 38.82 | **TFEE** | 48.70 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 20.30 |
| **% DPER < TPER** | -7.27 | **DPER** | 88.03 | **TPER** | 82.07 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Matthew Stainrod | **Assessor ID** | AU83-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 95.3800 | (1b) | x 2.5000 | (2b) = | 238.4500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.3800 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 238.4500 | (5) |

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## 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) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1258 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3758 | (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) = | 0.3194 | (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 | 0.4073 | 0.3993 | 0.3913 | 0.3514 | 0.3434 | 0.3035 | 0.3035 | 0.2955 | 0.3194 | 0.3434 | 0.3594 | 0.3753 | (22b) |
| Effective ac | 0.5829 | 0.5797 | 0.5766 | 0.5617 | 0.5590 | 0.5460 | 0.5460 | 0.5437 | 0.5510 | 0.5590 | 0.5646 | 0.5704 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| Glazing (Uw = 1.20) | | | 22.8600 | 1.1450 | 26.1756 | | | (27) |
| External Wall | 97.4200 | 24.9600 | 72.4600 | 0.1500 | 10.8690 | 9.0000 | 652.1400 | (29a) |
| Communal Wall | 18.9000 | | 18.9000 | 0.1500 | 2.8350 | 9.0000 | 170.1000 | (29a) |
| External Roof | 95.3500 | | 95.3500 | 0.1000 | 9.5350 | 9.0000 | 858.1500 | (30) |
| Total net area of external elements Aum(A, m2) | | | 211.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 51.5146 | | | (33) |
| Party Wall | | | 16.1500 | 0.0000 | 0.0000 | 20.0000 | 323.0000 | (32) |
| Party Floor | | | 95.3500 | | | 40.0000 | 3814.0000 | (32d) |
| Internal Wall | | | 100.0000 | | | 9.0000 | 900.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6717.3900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 70.4277 (35) |
| Thermal bridges (User defined value 0.050 * total exposed area) | | 10.5835 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 62.0981 (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 | 45.8708 | 45.6173 | 45.3689 | 44.2021 | 43.9838 | 42.9676 | 42.9676 | 42.7794 | 43.3590 | 43.9838 | 44.4255 | 44.8872 | (38) |

Heat transfer coeff

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 107.9688 | 107.7154 | 107.4670 | 106.3002 | 106.0819 | 105.0657 | 105.0657 | 104.8775 | 105.4571 | 106.0819 | 106.5235 | 106.9852 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 106.2992 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1320 | 1.1293 | 1.1267 | 1.1145 | 1.1122 | 1.1015 | 1.1015 | 1.0996 | 1.1057 | 1.1122 | 1.1168 | 1.1217 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1145 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6924 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 95.3744 | 93.9411 | 91.8525 | 87.8564 | 84.9074 | 81.6186 | 79.7493 | 81.8221 | 84.0942 | 87.6253 | 91.7073 | 95.0090 (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29.9517 | 29.5068 | 28.8804 | 27.7255 | 26.8606 | 25.9017 | 25.3837 | 26.0057 | 26.6830 | 27.7091 | 28.8879 | 29.8504 (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 42.2033 | 40.6687 | 39.1340 | 37.5993 | 36.0647 | 34.5300 | 34.5300 | 36.0647 | 37.5993 | 39.1340 | 40.6687 | 42.2033 (42c) |

Average daily hot water use (litres/day) 154.0686 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 167.5294 | 164.1166 | 159.8670 | 153.1812 | 147.8326 | 142.0503 | 139.6629 | 143.8924 | 148.3765 | 154.4684 | 161.2638 | 167.0627 | (44) |
| Energy conte | 265.3256 | 233.6999 | 245.7096 | 209.6974 | 199.0111 | 174.6674 | 168.9102 | 178.1689 | 182.9631 | 209.6122 | 229.7499 | 261.5799 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2559.0950 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 39.7988 | 35.0550 | 36.8564 | 31.4546 | 29.8517 | 26.2001 | 25.3365 | 26.7253 | 27.4445 | 31.4418 | 34.4625 | 39.2370 | (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 | | | | | | | | | | | | | |
| | 316.2845 | 279.7273 | 296.6685 | 259.0125 | 249.9700 | 223.9824 | 219.8691 | 229.1278 | 232.2781 | 260.5711 | 279.0649 | 312.5388 | (62) |
| WWHRS | -27.1296 | -23.9937 | -25.1248 | -20.8043 | -19.3889 | -16.5912 | -15.5516 | -16.5376 | -17.1659 | -20.2367 | -22.9257 | -26.6272 | (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 | | | | | | | | | | | | | |
| | 289.1549 | 255.7336 | 271.5437 | 238.2081 | 230.5812 | 207.3912 | 204.3175 | 212.5902 | 215.1122 | 240.3344 | 256.1392 | 285.9115 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2907.0178 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2907 | (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 | | | | | | | | | | | | | |
| | 100.9605 | 89.2121 | 94.4382 | 82.0531 | 78.9109 | 70.4057 | 68.9024 | 71.9809 | 73.1640 | 82.4358 | 88.7206 | 99.7150 | (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 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 125.4080 | 138.8445 | 125.4080 | 129.5882 | 125.4080 | 129.5882 | 125.4080 | 125.4080 | 129.5882 | 125.4080 | 129.5882 | 125.4080 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 248.6353 | 251.2154 | 244.7137 | 230.8724 | 213.4003 | 196.9790 | 186.0086 | 183.4285 | 189.9302 | 203.7714 | 221.2435 | 237.6649 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | (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) | | | | | | | | | | | | | |
| | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 135.6996 | 132.7560 | 126.9330 | 113.9627 | 106.0631 | 97.7856 | 92.6107 | 96.7485 | 101.6166 | 110.8008 | 123.2231 | 134.0256 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 576.1295 | 589.2026 | 563.4413 | 540.8100 | 511.2580 | 487.7396 | 467.4139 | 468.9716 | 484.5217 | 506.3668 | 540.4415 | 563.4851 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 6.1000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 21.0341 | (75) |
| Southeast | 3.3800 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 38.0070 | (77) |
| Northwest | 13.3800 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 46.1371 | (81) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 105.1782 | 201.4689 | 334.9221 | 514.3194 | 666.7486 | 701.8089 | 660.0217 | 540.2054 | 396.0851 | 238.6450 | 130.0424 | 87.3815 (83) |
| Total gains | 681.3077 | 790.6715 | 898.3634 | 1055.1294 | 1178.0067 | 1189.5485 | 1127.4356 | 1009.1770 | 880.6068 | 745.0119 | 670.4839 | 650.8665 (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 | 17.2822 | 17.3229 | 17.3629 | 17.5535 | 17.5896 | 17.7598 | 17.7598 | 17.7916 | 17.6938 | 17.5896 | 17.5167 | 17.4411 | |
| alpha | 2.1521 | 2.1549 | 2.1575 | 2.1702 | 2.1726 | 2.1840 | 2.1840 | 2.1861 | 2.1796 | 2.1726 | 2.1678 | 2.1627 | |
| util living area | | | | | | | | | | | | | |
| | 0.9197 | 0.8907 | 0.8434 | 0.7493 | 0.6223 | 0.4808 | 0.3734 | 0.4231 | 0.6181 | 0.8057 | 0.8931 | 0.9261 | (86) |
| MIT | 17.9169 | 18.2979 | 18.8974 | 19.6915 | 20.3302 | 20.7334 | 20.8903 | 20.8527 | 20.5141 | 19.6708 | 18.6740 | 17.8558 | (87) |
| Th 2 | 19.9748 | 19.9770 | 19.9791 | 19.9890 | 19.9909 | 19.9996 | 19.9996 | 20.0012 | 19.9962 | 19.9909 | 19.9871 | 19.9832 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9106 | 0.8787 | 0.8260 | 0.7216 | 0.5807 | 0.4222 | 0.2988 | 0.3457 | 0.5609 | 0.7773 | 0.8793 | 0.9178 | (89) |
| MIT 2 | 17.1657 | 17.5390 | 18.1235 | 18.8870 | 19.4743 | 19.8269 | 19.9456 | 19.9246 | 19.6573 | 18.8886 | 17.9214 | 17.1111 | (90) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Living area fraction | | | | | | | | | | | fLA = Living area / (4) = | 0.3710 | (91) |
| MIT | 17.4444 | 17.8206 | 18.4107 | 19.1855 | 19.7919 | 20.1632 | 20.2961 | 20.2690 | 19.9752 | 19.1788 | 18.2007 | 17.3874 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.2944 | 17.6706 | 18.2607 | 19.0355 | 19.6419 | 20.0132 | 20.1461 | 20.1190 | 19.8252 | 19.0288 | 18.0507 | 17.2374 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8789 | 0.8438 | 0.7901 | 0.6917 | 0.5650 | 0.4231 | 0.3102 | 0.3553 | 0.5501 | 0.7447 | 0.8452 | 0.8873 | (94) |
| Useful gains | 598.8003 | 667.2052 | 709.8013 | 729.8203 | 665.5830 | 503.2564 | 349.6771 | 358.5647 | 484.4522 | 554.8106 | 566.6898 | 577.5095 | (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 | 1402.9926 | 1375.5888 | 1263.8851 | 1077.4075 | 842.4918 | 568.7423 | 372.5711 | 390.0342 | 603.7637 | 894.1421 | 1166.5032 | 1394.8098 | (97) |
| Space heating kWh | 598.3190 | 476.0338 | 412.2383 | 250.2628 | 131.6201 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 252.4626 | 431.8657 | 608.0714 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 3160.8737 | |
| 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 | 598.3190 | 476.0338 | 412.2383 | 250.2628 | 131.6201 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 252.4626 | 431.8657 | 608.0714 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 3160.8737 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.1398 | (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 %) | | | | | | | | | | | | 88.9000 | (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 | 598.3190 | 476.0338 | 412.2383 | 250.2628 | 131.6201 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 252.4626 | 431.8657 | 608.0714 | (98) |
| Space heating efficiency (main heating system 1) | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 88.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.9000 | 88.9000 | 88.9000 | (210) |
| Space heating fuel (main heating system) | 673.0248 | 535.4711 | 463.7101 | 281.5105 | 148.0541 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 283.9849 | 485.7882 | 683.9948 | (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 | 289.1549 | 255.7336 | 271.5437 | 238.2081 | 230.5812 | 207.3912 | 204.3175 | 212.5902 | 215.1122 | 240.3344 | 256.1392 | 285.9115 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 85.9025 | 85.6927 | 85.2732 | 84.4874 | 83.2257 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.4871 | 85.4913 | 85.9558 | (217) |
| Fuel for water heating, kWh/month | 336.6084 | 298.4311 | 318.4395 | 281.9451 | 277.0553 | 258.2705 | 254.4427 | 264.7449 | 267.8857 | 284.4627 | 299.6085 | 332.6261 | (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 | 26.0573 | 20.9041 | 18.8219 | 13.7897 | 10.6516 | 8.7024 | 9.7167 | 12.6301 | 16.4053 | 21.5247 | 24.3120 | 26.7815 | (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) | | | | | | | | | | | | | |
| (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 | 3555.5385 | (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 | 3474.5206 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| central heating pump | 41.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 210.2973 | (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 | 7326.3564 | (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 | 3555.5385 | 0.2100 | 746.6631 | (261) |

| | | | | |
|---|---|---|---|---|
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3474.5206 | 0.2100 | 729.6493 | (264) |
| Space and water heating | | | 1476.3124 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 210.2973 | 0.1443 | 30.3524 | (268) |
| Total CO2, kg/year | | | 1518.5941 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 15.9200 | (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 | 3555.5385 | 1.1300 | 4017.7585 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3474.5206 | 1.1300 | 3926.2083 | (278) |
| Space and water heating | | | 7943.9668 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 210.2973 | 1.5338 | 322.5610 | (282) |
| Total Primary energy kWh/year | | | 8396.6286 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 88.0300 | (287) |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 95.3800 | (1b) | x 2.5000 | (2b) = | 238.4500 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 95.3800 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 238.4500 | (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) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1258 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 5.0000 (17) |
| Infiltration rate | | 0.3758 (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) = | 0.3194 (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 | 0.4073 | 0.3993 | 0.3913 | 0.3514 | 0.3434 | 0.3035 | 0.3035 | 0.2955 | 0.3194 | 0.3434 | 0.3594 | 0.3753 | (22b) |
| Effective ac | 0.5829 | 0.5797 | 0.5766 | 0.5617 | 0.5590 | 0.5460 | 0.5460 | 0.5437 | 0.5510 | 0.5590 | 0.5646 | 0.5704 | (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.20) | | | 21.7500 | 1.1450 | 24.9046 | | | (27) |
| External Wall | 97.4200 | 23.8500 | 73.5700 | 0.1800 | 13.2426 | | | (29a) |
| Communal Wall | 18.9000 | | 18.9000 | 0.1800 | 3.4020 | | | (29a) |
| External Roof | 95.3500 | | 95.3500 | 0.1100 | 10.4885 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 211.6700 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 54.1377 | | | (33) |
| Party Wall | | | 16.1500 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 70.4277 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 13.7700 | 0.0500 | 0.6885 |
| E3 Sill | 8.7500 | 0.0500 | 0.4375 |
| E4 Jamb | 42.2300 | 0.0500 | 2.1115 |
| E7 Party floor between dwellings (in blocks of flats) | 37.4000 | 0.0700 | 2.6180 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 9.1200 | 0.0200 | 0.1824 |
| E14 Flat roof | 7.5600 | 0.0800 | 0.6048 |
| E15 Flat roof with parapet | 38.9600 | 0.5600 | 21.8176 |
| E16 Corner (normal) | 17.5000 | 0.0900 | 1.5750 |

| | | | | |
|---|---|---|---|---|
| E18 Party wall between dwellings | 5.0000 | 0.0600 | 0.3000 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 6.4600 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 6.4600 | 0.1200 | 0.7752 | |
| E17 Corner (inverted - internal area greater than external area) | 7.5000 | -0.0900 | -0.6750 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 30.4355 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 84.5732 (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 | 45.8708 | 45.6173 | 45.3689 | 44.2021 | 43.9838 | 42.9676 | 42.9676 | 42.7794 | 43.3590 | 43.9838 | 44.4255 | 44.8872 | (38) |
| Heat transfer coeff | 130.4440 | 130.1905 | 129.9421 | 128.7753 | 128.5570 | 127.5408 | 127.5408 | 127.3526 | 127.9322 | 128.5570 | 128.9986 | 129.4603 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 128.7743 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.3676 | 1.3650 | 1.3624 | 1.3501 | 1.3478 | 1.3372 | 1.3372 | 1.3352 | 1.3413 | 1.3478 | 1.3525 | 1.3573 | (40) |
| HLP (average) | | | | | | | | | | | | 1.3501 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

Assumed occupancy 2.6924 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 69.3632 | 68.3208 | 66.8018 | 63.8956 | 61.7508 | 59.3590 | 57.9995 | 59.5069 | 61.1594 | 63.7275 | 66.6962 | 69.0975 | (42a) |
| Hot water usage for baths | 29.9517 | 29.5068 | 28.8804 | 27.7255 | 26.8606 | 25.9017 | 25.3837 | 26.0057 | 26.6830 | 27.7091 | 28.8879 | 29.8504 | (42b) |
| Hot water usage for other uses | 42.2033 | 40.6687 | 39.1340 | 37.5993 | 36.0647 | 34.5300 | 34.5300 | 36.0647 | 37.5993 | 39.1340 | 40.6687 | 42.2033 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 130.0871 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 141.5182 | 138.4963 | 134.8163 | 129.2203 | 124.6761 | 119.7906 | 117.9131 | 121.5773 | 125.4417 | 130.5706 | 136.2527 | 141.1512 | (44) |
| Energy conte | 224.1302 | 197.2169 | 207.2076 | 176.8962 | 167.8380 | 147.2966 | 142.6057 | 150.5381 | 154.6822 | 177.1831 | 194.1170 | 221.0086 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2160.7202 | |
| Distribution loss (46)m = 0.15 x (45)m | 33.6195 | 29.5825 | 31.0811 | 26.5344 | 25.1757 | 22.0945 | 21.3909 | 22.5807 | 23.2023 | 26.5775 | 29.1175 | 33.1513 | (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 | 275.0891 | 243.2443 | 258.1665 | 226.2113 | 218.7969 | 196.6116 | 193.5646 | 201.4970 | 203.9973 | 228.1420 | 243.4321 | 271.9676 | (62) |
| WWHRS | -31.7100 | -28.0446 | -29.3666 | -24.3167 | -22.6623 | -19.3923 | -18.1772 | -19.3296 | -20.0640 | -23.6533 | -26.7963 | -31.1227 | (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 | 243.3792 | 215.1998 | 228.7999 | 201.8945 | 196.1346 | 177.2193 | 175.3874 | 182.1674 | 183.9332 | 204.4887 | 216.6358 | 240.8448 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2466.0845 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2466 | (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 | 87.2630 | 77.0815 | 81.6363 | 71.1468 | 68.5459 | 61.3049 | 60.1561 | 62.7936 | 63.7606 | 71.6531 | 76.8727 | 86.2251 | (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 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | 134.6222 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 125.3824 | 138.8162 | 125.3824 | 129.5618 | 125.3824 | 129.5618 | 125.3824 | 125.3824 | 129.5618 | 125.3824 | 129.5618 | 125.3824 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 248.6353 | 251.2154 | 244.7137 | 230.8724 | 213.4003 | 196.9790 | 186.0086 | 183.4285 | 189.9302 | 203.7714 | 221.2435 | 237.6649 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | 36.4622 | (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) | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | -107.6978 | (71) |
| Water heating gains (Table 5) | 117.2890 | 114.7046 | 109.7261 | 98.8149 | 92.1315 | 85.1457 | 80.8550 | 84.4001 | 88.5564 | 96.3079 | 106.7676 | 115.8940 | (72) |
| Total internal gains | 557.6934 | 571.1228 | 546.2089 | 525.6359 | 497.3009 | 475.0732 | 455.6327 | 456.5976 | 471.4350 | 491.8484 | 523.9596 | 545.3279 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| Northeast | 5.8000 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 19.9996 | (75) |
| Southeast | 3.2200 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 36.2078 | (77) |
| Northwest | 12.7300 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 43.8958 | (81) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 100.1032 | 191.7363 | 318.7153 | 489.3941 | 634.4085 | 667.7577 | 628.0021 | 514.0149 | 376.9060 | 227.1092 | 123.7656 | 83.1666 | (83) |
| Total gains | 657.7966 | 762.8591 | 864.9243 | 1015.0299 | 1131.7095 | 1142.8309 | 1083.6348 | 970.6126 | 848.3411 | 718.9576 | 647.7252 | 628.4945 | (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 | 14.3045 | 14.3324 | 14.3598 | 14.4899 | 14.5145 | 14.6302 | 14.6302 | 14.6518 | 14.5854 | 14.5145 | 14.4648 | 14.4132 | |
| alpha | 1.9536 | 1.9555 | 1.9573 | 1.9660 | 1.9676 | 1.9753 | 1.9753 | 1.9768 | 1.9724 | 1.9676 | 1.9643 | 1.9609 | |
| util living area | 0.9307 | 0.9072 | 0.8691 | 0.7914 | 0.6811 | 0.5483 | 0.4386 | 0.4901 | 0.6767 | 0.8379 | 0.9091 | 0.9361 | (86) |
| MIT | 17.2750 | 17.6572 | 18.3008 | 19.1918 | 19.9815 | 20.5433 | 20.7932 | 20.7347 | 20.2579 | 19.2388 | 18.1183 | 17.2106 | (87) |
| Th 2 | 19.7882 | 19.7903 | 19.7923 | 19.8018 | 19.8035 | 19.8118 | 19.8118 | 19.8134 | 19.8086 | 19.8035 | 19.8000 | 19.7962 | (88) |
| util rest of house | 0.9218 | 0.8955 | 0.8519 | 0.7630 | 0.6352 | 0.4774 | 0.3416 | 0.3922 | 0.6128 | 0.8093 | 0.8956 | 0.9279 | (89) |
| MIT 2 | 15.5320 | 16.0066 | 16.8039 | 17.8922 | 18.8229 | 19.4483 | 19.6913 | 19.6484 | 19.1676 | 17.9771 | 16.5927 | 15.4535 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3710 | (91) |
| MIT | 16.1787 | 16.6190 | 17.3593 | 18.3744 | 19.2528 | 19.8546 | 20.1002 | 20.0515 | 19.5722 | 18.4452 | 17.1588 | 16.1055 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 16.1787 | 16.6190 | 17.3593 | 18.3744 | 19.2528 | 19.8546 | 20.1002 | 20.0515 | 19.5722 | 18.4452 | 17.1588 | 16.1055 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8828 | 0.8520 | 0.8059 | 0.7217 | 0.6112 | 0.4802 | 0.3667 | 0.4135 | 0.5982 | 0.7672 | 0.8534 | 0.8903 | (94) |
| Useful gains | 580.6714 | 649.9580 | 697.0077 | 732.5425 | 691.6915 | 548.7958 | 397.3754 | 401.3410 | 507.5168 | 551.6031 | 552.7531 | 559.5518 | (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 | 1549.5065 | 1525.7038 | 1411.0821 | 1220.0675 | 970.9648 | 670.1760 | 446.4159 | 465.0248 | 700.0669 | 1008.5606 | 1297.5679 | 1541.2867 | (97) |
| Space heating kWh | 720.8133 | 588.5012 | 531.2714 | 351.0180 | 207.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 339.9764 | 536.2667 | 730.4108 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 4006.0371 | |
| 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 | 720.8133 | 588.5012 | 531.2714 | 351.0180 | 207.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 339.9764 | 536.2667 | 730.4108 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 4006.0371 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 42.0008 | (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 | 720.8133 | 588.5012 | 531.2714 | 351.0180 | 207.7793 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 339.9764 | 536.2667 | 730.4108 | (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) | 780.1010 | 636.9060 | 574.9690 | 379.8897 | 224.8694 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 367.9398 | 580.3752 | 790.4878 | (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 | 243.3792 | 215.1998 | 228.7999 | 201.8945 | 196.1346 | 177.2193 | 175.3874 | 182.1674 | 183.9332 | 204.4887 | 216.6358 | 240.8448 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.5600 | 86.4217 | 86.1234 | 85.5543 | 84.5053 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.4624 | 86.2424 | 86.6001 | (217) |
| Fuel for water heating, kWh/month | 281.1683 | 249.0112 | 265.6650 | 235.9842 | 232.0974 | 220.6965 | 218.4152 | 226.8585 | 229.0576 | 239.2733 | 251.1941 | 278.1114 | (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 | 26.0520 | 20.8999 | 18.8180 | 13.7869 | 10.6494 | 8.7006 | 9.7147 | 12.6276 | 16.4020 | 21.5203 | 24.3071 | 26.7761 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -17.8403 | -26.8803 | -41.2566 | -49.6260 | -56.3857 | -53.6742 | -53.0053 | -48.5926 | -41.3550 | -32.1073 | -20.2124 | -15.2281 | (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 | -5.4356 | -11.7652 | -24.0213 | -37.0431 | -49.9526 | -50.5655 | -49.9875 | -41.8877 | -30.1257 | -17.1513 | -7.3581 | -4.2752 | (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 | 4335.5379 | (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 | 2927.5328 | (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) | 210.2545 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -785.7326 | (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 | 6773.5926 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4335.5379 | 0.2100 | 910.4630 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2927.5328 | 0.2100 | 614.7819 | (264) |
| Space and water heating | | | 1525.2449 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 210.2545 | 0.1443 | 30.3462 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -456.1638 | 0.1332 | -60.7735 | |
| PV Unit electricity exported | -329.5688 | 0.1251 | -41.2368 | |
| Total | | | -102.0103 | (269) |
| Total CO2, kg/year | | | 1465.5100 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.3600 | (273) |

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 4335.5379 | 1.1300 | 4899.1579 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2927.5328 | 1.1300 | 3308.1120 | (278) |
| Space and water heating | | | 8207.2699 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 210.2545 | 1.5338 | 322.4953 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -456.1638 | 1.4923 | -680.7370 | |
| PV Unit electricity exported | -329.5688 | 0.4593 | -151.3547 | |
| Total | | | -832.0917 | (283) |
| Total Primary energy kWh/year | | | 7827.7744 | (286) |
| Target Primary Energy Rate (TPER) | | | 82.0700 | (287) |