# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | 78449-20 | **Issued on Date** | 18/08/2025 |
| **Assessment Reference** | 001 | **Prop Type Ref** | Top Flat / End |
| **Property** | 10 Shepherd Street, MANCHESTER, M9 4QW | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 81 B | **DER** | 5.82 | **TER** | 15.12 |
| **Environmental** | 96 A | **% DER < TER** | | | 61.51 |
| **$CO_2$ Emissions (t/year)** | 0.27 | **DFEE** | 36.57 | **TFEE** | 40.67 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 10.09 |
| **% DPER < TPER** | 23.79 | **DPER** | 60.83 | **TPER** | 79.82 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Daniel Goddard | **Assessor ID** | CP52-0001 |
| **Client** | | | |

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

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (5) |

## 2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 2.6400 | (17) |
| Infiltration rate | | 0.1320 | (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) = | 0.1122 | (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 | 0.1431 | 0.1403 | 0.1374 | 0.1234 | 0.1206 | 0.1066 | 0.1066 | 0.1038 | 0.1122 | 0.1206 | 0.1262 | 0.1318 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2426 | 0.2397 | 0.2369 | 0.2229 | 0.2201 | 0.2061 | 0.2061 | 0.2033 | 0.2117 | 0.2201 | 0.2257 | 0.2313 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Door | | | 2.1500 | 0.7800 | 1.6770 | | | (26) |
| Window | | | 5.7300 | 0.7282 | 4.1723 | | | (27) |
| GF | | | 3.0200 | 0.0900 | 0.2718 | 75.0000 | 226.5000 | (28a) |
| Exposed Floor | | | 1.6100 | 0.1400 | 0.2254 | 20.0000 | 32.2000 | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1300 | 7.7236 | 9.0000 | 534.7089 | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | 9.0000 | 412.6500 | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1200 | 0.3624 | 9.0000 | 27.1800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.4760 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | 20.0000 | 533.0000 | (32) |
| Party Floor 1 | | | 37.9700 | | | 30.0000 | 1139.1000 | (32d) |
| Timber | | | 50.4000 | | | 9.0000 | 453.6000 | (32c) |
| Internal Floor 1 | | | 6.2700 | | | 18.0000 | 112.8600 | (32d) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 3471.7989 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 71.0415 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.1150 | 0.6670 |
| E3 Sill | 5.8000 | 0.0170 | 0.0986 |
| E4 Jamb | 16.2000 | 0.0940 | 1.5228 |
| E5 Ground floor (normal) | 2.0100 | 0.0670 | 0.1347 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0320 | 0.6992 |
| E16 Corner (normal) | 10.0800 | 0.0680 | 0.6854 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0290 | -0.1462 |
| P1 Party wall - Ground floor | 5.1000 | 0.0560 | 0.2856 |
| E18 Party wall between dwellings | 11.4000 | 0.2400 | 2.7360 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0560 | 0.2822 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0320 | 0.0826 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0420 | 0.6707 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0770 | 0.6514 |
| E14 Flat roof | 2.0100 | 0.2050 | 0.4120 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.1500 | 0.3015 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1020 | 0.5008 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.4800 | 1.4400 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6501 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.1261 (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 | 9.9373 | 9.8224 | 9.7074 | 9.1328 | 9.0179 | 8.4433 | 8.4433 | 8.3284 | 8.6732 | 9.0179 | 9.2478 | 9.4776 | (38) |
| Heat transfer coeff | 42.0634 | 41.9484 | 41.8335 | 41.2589 | 41.1440 | 40.5694 | 40.5694 | 40.4545 | 40.7993 | 41.1440 | 41.3738 | 41.6037 | (39) |

Average = Sum(39)m / 12 = 41.2302

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8607 | 0.8584 | 0.8560 | 0.8443 | 0.8419 | 0.8301 | 0.8301 | 0.8278 | 0.8349 | 0.8419 | 0.8466 | 0.8513 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8437 | |
| 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 1.6569 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

Average daily hot water use (litres/day) 97.5150 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 200.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.6100 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.8694 | (55) |
| Total storage loss | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (56) |
| If cylinder contains dedicated solar storage | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (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 | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (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 | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1937.0342 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1937 | (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 | 55.8632 | 49.1556 | 51.6461 | 44.0910 | 41.8334 | 36.7136 | 35.5441 | 37.5210 | 38.5537 | 44.1619 | 48.3826 | 55.0851 | (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 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 83.5900 | 92.5461 | 83.5900 | 86.3763 | 83.5900 | 86.3763 | 83.5900 | 83.5900 | 86.3763 | 83.5900 | 86.3763 | 83.5900 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 144.2994 | 145.7968 | 142.0235 | 133.9905 | 123.8503 | 114.3199 | 107.9530 | 106.4556 | 110.2290 | 118.2620 | 128.4022 | 137.9326 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | (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) | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | 75.0850 | 73.1483 | 69.4168 | 61.2375 | 56.2277 | 50.9911 | 47.7744 | 50.4314 | 53.5468 | 59.3573 | 67.1981 | 74.0392 | (72) |
| Total internal gains | 350.8277 | 359.3444 | 342.8835 | 329.4576 | 311.5213 | 299.5406 | 287.1707 | 288.3304 | 298.0054 | 309.0626 | 329.8299 | 343.4150 | (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 | 2.8600 | 10.6334 | 0.3800 | 0.0000 | 0.7700 | 8.8984 | (74) |
| South | 2.0500 | 46.7521 | 0.3800 | 0.0000 | 0.7700 | 28.0433 | (78) |
| West | 0.8200 | 19.6403 | 0.3800 | 0.0000 | 0.7700 | 4.7123 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 41.6540 | 72.1513 | 102.5811 | 134.6775 | 158.5625 | 161.0216 | 153.7257 | 135.2141 | 113.5130 | 80.7182 | 50.0939 | 35.5253 | (83) |
| Total gains | 392.4818 | 431.4958 | 445.4647 | 464.1351 | 470.0837 | 460.5622 | 440.8964 | 423.5445 | 411.5184 | 389.7808 | 379.9238 | 378.9404 | (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 | 22.9270 | 22.9899 | 23.0530 | 23.3741 | 23.4393 | 23.7713 | 23.7713 | 23.8388 | 23.6374 | 23.4393 | 23.3091 | 23.1804 | |
| alpha | 2.5285 | 2.5327 | 2.5369 | 2.5583 | 2.5626 | 2.5848 | 2.5848 | 2.5893 | 2.5758 | 2.5626 | 2.5539 | 2.5454 | |
| util living area | 0.8838 | 0.8539 | 0.8173 | 0.7446 | 0.6420 | 0.4996 | 0.3806 | 0.4085 | 0.5747 | 0.7520 | 0.8473 | 0.8912 | (86) |
| MIT | 18.9551 | 19.2329 | 19.6023 | 20.1096 | 20.5309 | 20.8276 | 20.9377 | 20.9235 | 20.7378 | 20.2178 | 19.5340 | 18.9132 | (87) |
| Th 2 | 20.2010 | 20.2030 | 20.2050 | 20.2151 | 20.2172 | 20.2273 | 20.2273 | 20.2293 | 20.2232 | 20.2172 | 20.2131 | 20.2091 | (88) |
| util rest of house | 0.8733 | 0.8411 | 0.8008 | 0.7211 | 0.6077 | 0.4514 | 0.3205 | 0.3481 | 0.5278 | 0.7247 | 0.8320 | 0.8813 | (89) |
| MIT 2 | 17.7947 | 18.1417 | 18.6031 | 19.2320 | 19.7349 | 20.0744 | 20.1834 | 20.1733 | 19.9795 | 19.3741 | 18.5307 | 17.7476 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 18.2487 | 18.5686 | 18.9940 | 19.5753 | 20.0464 | 20.3691 | 20.4785 | 20.4668 | 20.2762 | 19.7042 | 18.9232 | 18.2036 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.2487 | 18.5686 | 18.9940 | 19.5753 | 20.0464 | 20.3691 | 20.4785 | 20.4668 | 20.2762 | 19.7042 | 18.9232 | 18.2036 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8420 | 0.8099 | 0.7720 | 0.6999 | 0.5997 | 0.4605 | 0.3405 | 0.3672 | 0.5312 | 0.7049 | 0.8024 | 0.8505 | (94) |
| Useful gains | 330.4567 | 349.4810 | 343.8769 | 324.8445 | 281.9323 | 212.1001 | 150.1119 | 155.5234 | 218.5885 | 274.7413 | 304.8530 | 322.2875 | (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 | 586.7290 | 573.3759 | 522.6701 | 440.4520 | 343.4032 | 234.0487 | 157.3476 | 164.5214 | 251.9842 | 374.5833 | 489.1722 | 582.6019 | (97) |
| Space heating kWh | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1003.7841 | |
| 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 | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1003.7841 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 20.5399 | (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) |
| Fraction of main heating from main system 2 | 0.0000 | (203) |
| Fraction of total heating from main system 1 | 1.0000 | (204) |
| Fraction of total heating from main system 2 | 0.0000 | (205) |
| Efficiency of main space heating system 1 (in %) | 100.0000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (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) |
| Space heating fuel used, main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 324.5200 | (216) |
| (217)m | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | (217) |
| Fuel for water heating, kWh/month | 60.0768 | 53.0567 | 56.1685 | 48.8988 | 47.0745 | 42.0617 | 41.2458 | 43.0779 | 43.7671 | 49.2324 | 52.8761 | 59.3557 | (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 | 15.6682 | 14.1519 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | (231) |
| Lighting | 16.7415 | 13.4307 | 12.0928 | 8.8597 | 6.8435 | 5.5912 | 6.2429 | 8.1147 | 10.5402 | 13.8293 | 15.6202 | 17.2068 | (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 | 1003.7841 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 324.5200 | |
| Water heating fuel used | 596.8921 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2180) | | |
| mechanical ventilation fans (SFP = 1.2180) | 184.4804 | (230a) |
| Total electricity for the above, kWh/year | 184.4804 | (231) |
| Electricity for lighting (calculated in Appendix L) | 135.1135 | (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 | 1920.2701 | (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 | 1003.7841 | 0.1546 | 155.1546 | (261) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (262) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 596.8921 | 0.1411 | 84.2266 | (264) |
| Space and water heating | | | 239.3812 | (265) |
| Pumps, fans and electric keep-hot | 184.4804 | 0.1387 | 25.5897 | (267) |
| Energy for lighting | 135.1135 | 0.1443 | 19.5011 | (268) |
| Total CO2, kg/year | | | 284.4719 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.8200 | (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 | 1003.7841 | 1.5723 | 1578.2011 | (275) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (276) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 1.5218 | 908.3378 | (278) |
| Space and water heating | | | 2486.5389 | (279) |
| Pumps, fans and electric keep-hot | 184.4804 | 1.5128 | 279.0820 | (281) |
| Energy for lighting | 135.1135 | 1.5338 | 207.2416 | (282) |
| Total Primary energy kWh/year | | | 2972.8625 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 60.8300 | (287) |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (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 | 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) = | 0.1611 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |

| | | |
|---|---|---|
| Infiltration rate | | 0.4111 (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) = | 0.3494 (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 | 0.4455 | 0.4368 | 0.4281 | 0.3844 | 0.3756 | 0.3320 | 0.3320 | 0.3232 | 0.3494 | 0.3756 | 0.3931 | 0.4106 | (22b) |
| Effective ac | 0.5992 | 0.5954 | 0.5916 | 0.5739 | 0.5706 | 0.5551 | 0.5551 | 0.5522 | 0.5611 | 0.5706 | 0.5773 | 0.5843 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.1500 | 1.0000 | 2.1500 | | | (26) |
| TER Opening Type | | | 5.7300 | 1.1450 | 6.5611 | | | (27) |
| GF | | | 3.0200 | 0.1300 | 0.3926 | | | (28a) |
| Exposed Floor | | | 1.6100 | 0.1300 | 0.2093 | | | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1800 | 10.6942 | | | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | | | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1100 | 0.3322 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 25.3828 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 71.0415 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.0500 | 0.2900 |
| E3 Sill | 5.8000 | 0.0500 | 0.2900 |
| E4 Jamb | 16.2000 | 0.0500 | 0.8100 |
| E5 Ground floor (normal) | 2.0100 | 0.1600 | 0.3216 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0700 | 1.5295 |
| E16 Corner (normal) | 10.0800 | 0.0900 | 0.9072 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0900 | -0.4536 |
| P1 Party wall - Ground floor | 5.1000 | 0.0800 | 0.4080 |
| E18 Party wall between dwellings | 11.4000 | 0.0600 | 0.6840 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0600 | 0.3024 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0000 | 0.0000 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0600 | 0.9582 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0600 | 0.5076 |
| E14 Flat roof | 2.0100 | 0.0800 | 0.1608 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.2400 | 0.4824 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1200 | 0.5892 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.0800 | 0.2400 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 9.6529 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 35.0357 (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 | 24.5506 | 24.3928 | 24.2380 | 23.5111 | 23.3751 | 22.7419 | 22.7419 | 22.6247 | 22.9858 | 23.3751 | 23.6502 | 23.9378 | (38) |
| Heat transfer coeff | 59.5864 | 59.4285 | 59.2737 | 58.5468 | 58.4108 | 57.7777 | 57.7777 | 57.6604 | 58.0216 | 58.4108 | 58.6859 | 58.9736 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 58.5462 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2193 | 1.2161 | 1.2129 | 1.1980 | 1.1952 | 1.1823 | 1.1823 | 1.1799 | 1.1873 | 1.1952 | 1.2009 | 1.2067 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1980 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | |
|---|---|
| Assumed occupancy | 1.6569 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 97.5150 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 214.6047 | 189.9222 | 201.9214 | 177.6964 | 172.4096 | 155.5086 | 153.4945 | 159.4400 | 161.0427 | 179.4125 | 190.6035 | 212.2645 | (62) |
| WWHRS | -23.7722 | -21.0244 | -22.0155 | -18.2297 | -16.9894 | -14.5380 | -13.6270 | -14.4910 | -15.0415 | -17.7323 | -20.0886 | -23.3320 | (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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 190.8324 | 168.8978 | 179.9059 | 159.4667 | 155.4202 | 140.9706 | 139.8675 | 144.9490 | 146.0012 | 161.6802 | 170.5149 | 188.9325 | (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | 1947.4390 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1947 | (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 | | | | | | | | | | | | | |
| | 93.1392 | 82.8242 | 88.9220 | 80.1645 | 79.1093 | 72.7870 | 72.8200 | 74.7969 | 74.6271 | 81.4378 | 84.4561 | 92.3611 | (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 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 81.2011 | 89.9012 | 81.2011 | 83.9078 | 81.2011 | 83.9078 | 81.2011 | 81.2011 | 83.9078 | 81.2011 | 83.9078 | 81.2011 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 144.2994 | 145.7968 | 142.0235 | 133.9905 | 123.8503 | 114.3199 | 107.9530 | 106.4556 | 110.2290 | 118.2620 | 128.4022 | 137.9326 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 125.1871 | 123.2503 | 119.5188 | 111.3395 | 106.3297 | 101.0931 | 97.8764 | 100.5335 | 103.6488 | 109.4594 | 117.3001 | 124.1412 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 401.5409 | 409.8016 | 393.5967 | 380.0911 | 362.2344 | 347.1741 | 334.8838 | 336.0435 | 345.6389 | 359.7758 | 380.4634 | 394.1282 | (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 | 2.8600 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 9.2941 | (74) |
| South | 2.0500 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 29.2905 | (78) |
| West | 0.8200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 4.9219 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 43.5065 | 75.3601 | 107.1433 | 140.6671 | 165.6143 | 168.1828 | 160.5625 | 141.2276 | 118.5614 | 84.3081 | 52.3218 | 37.1053 | (83) |
| Total gains | 445.0474 | 485.1618 | 500.7400 | 520.7582 | 527.8487 | 515.3569 | 495.4463 | 477.2711 | 464.2003 | 444.0838 | 432.7852 | 431.2334 | (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 | 16.1847 | 16.2277 | 16.2701 | 16.4721 | 16.5104 | 16.6914 | 16.6914 | 16.7253 | 16.6212 | 16.5104 | 16.4330 | 16.3529 | |
| alpha | 2.0790 | 2.0818 | 2.0847 | 2.0981 | 2.1007 | 2.1128 | 2.1128 | 2.1150 | 2.1081 | 2.1007 | 2.0955 | 2.0902 | |
| util living area | | | | | | | | | | | | | |
| | 0.8867 | 0.8632 | 0.8331 | 0.7740 | 0.6872 | 0.5615 | 0.4434 | 0.4709 | 0.6269 | 0.7759 | 0.8553 | 0.8925 | (86) |
| MIT | 18.0516 | 18.3549 | 18.8226 | 19.4876 | 20.1049 | 20.5991 | 20.8277 | 20.7978 | 20.4560 | 19.6963 | 18.7955 | 18.0098 | (87) |
| Th 2 | 19.9046 | 19.9072 | 19.9097 | 19.9216 | 19.9238 | 19.9342 | 19.9342 | 19.9361 | 19.9302 | 19.9238 | 19.9193 | 19.9146 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8743 | 0.8484 | 0.8141 | 0.7464 | 0.6451 | 0.4964 | 0.3547 | 0.3836 | 0.5667 | 0.7436 | 0.8373 | 0.8807 | (89) |
| MIT 2 | 16.5191 | 16.8959 | 17.4784 | 18.2996 | 19.0385 | 19.6007 | 19.8266 | 19.8036 | 19.4523 | 18.5667 | 17.4573 | 16.4706 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3912 | (91) |
| MIT | 17.1187 | 17.4667 | 18.0043 | 18.7644 | 19.4557 | 19.9913 | 20.2183 | 20.1926 | 19.8450 | 19.0086 | 17.9809 | 17.0728 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.1187 | 17.4667 | 18.0043 | 18.7644 | 19.4557 | 19.9913 | 20.2183 | 20.1926 | 19.8450 | 19.0086 | 17.9809 | 17.0728 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8325 | 0.8059 | 0.7728 | 0.7115 | 0.6245 | 0.5001 | 0.3797 | 0.4060 | 0.5614 | 0.7109 | 0.7963 | 0.8396 | (94) |
| Useful gains | 370.4933 | 390.9897 | 386.9657 | 370.5384 | 329.6269 | 257.7521 | 188.1079 | 193.7498 | 260.5952 | 315.7120 | 344.6092 | 362.0700 | (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 | | | | | | | | | | | | | |
| | 763.8196 | 746.8206 | 681.9015 | 577.5299 | 453.0180 | 311.4968 | 209.0571 | 218.6804 | 333.3343 | 491.1537 | 638.5562 | 759.1545 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 292.6348 | 239.1184 | 219.4322 | 149.0339 | 91.8029 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.5286 | 211.6418 | 295.4309 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1629.6235 | |
| 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 | | | | | | | | | | | | | |
| | 292.6348 | 239.1184 | 219.4322 | 149.0339 | 91.8029 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.5286 | 211.6418 | 295.4309 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1629.6235 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.3461 | (99) |

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

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 292.6348 | 239.1184 | 219.4322 | 149.0339 | 91.8029 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.5286 | 211.6418 | 295.4309 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 317.0474 | 259.0665 | 237.7380 | 161.4668 | 99.4615 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 141.4178 | 229.2977 | 320.0768 (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 | | | | | | | | | | | | |
| | 190.8324 | 168.8978 | 179.9059 | 159.4667 | 155.4202 | 140.9706 | 139.8675 | 144.9490 | 146.0012 | 161.6802 | 170.5149 | 188.9325 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.0154 | 84.8392 | 84.5063 | 83.9083 | 82.9208 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.5841 | 84.5455 | 85.0581 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 224.4681 | 199.0799 | 212.8906 | 190.0487 | 187.4322 | 176.6549 | 175.2725 | 181.6404 | 182.9589 | 193.4341 | 201.6842 | 222.1216 (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 | 16.8720 | 13.5353 | 12.1871 | 8.9288 | 6.8968 | 5.6348 | 6.2915 | 8.1780 | 10.6224 | 13.9371 | 15.7419 | 17.3409 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -23.3618 | -33.1899 | -48.0847 | -54.5349 | -59.2499 | -55.5210 | -54.9018 | -51.6559 | -45.9280 | -38.2405 | -25.7999 | -20.1733 (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 | -12.4159 | -26.2127 | -52.2550 | -78.6854 | -104.2042 | -104.7074 | -103.4098 | -87.4228 | -63.9461 | -37.4757 | -16.5791 | -9.8055 (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 | 1765.5726 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2347.6863 (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) | 136.1665 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -1207.7611 (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 | 3127.6643 (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 | 1765.5726 | 0.2100 | 370.7702 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2347.6863 | 0.2100 | 493.0141 | (264) |
| Space and water heating | | | 863.7844 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 136.1665 | 0.1443 | 19.6530 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -510.6416 | 0.1344 | -68.6248 | |
| PV Unit electricity exported | -697.1195 | 0.1258 | -87.7220 | |
| Total | | | -156.3468 | (269) |
| Total CO2, kg/year | | | 739.0198 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.1200 | (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 | 1765.5726 | 1.1300 | 1995.0970 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2347.6863 | 1.1300 | 2652.8855 | (278) |
| Space and water heating | | | 4647.9825 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 136.1665 | 1.5338 | 208.8568 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -510.6416 | 1.4967 | -764.2616 | |
| PV Unit electricity exported | -697.1195 | 0.4619 | -321.9990 | |
| Total | | | -1086.2606 | (283) |
| Total Primary energy kWh/year | | | 3900.6795 | (286) |
| Target Primary Energy Rate (TPER) | | | 79.8200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | 78449-20 | **Issued on Date** | 18/08/2025 |
| **Assessment Reference** | 001 | **Prop Type Ref** | Top Flat / End |
| **Property** | 10 Shepherd Street, MANCHESTER, M9 4QW | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 81 B | **DER** | 5.82 | **TER** | 15.12 |
| **Environmental** | 96 A | **% DER < TER** | | | 61.51 |
| **$CO_2$ Emissions (t/year)** | 0.27 | **DFEE** | 36.57 | **TFEE** | 40.67 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 10.09 |
| **% DPER < TPER** | 23.79 | **DPER** | 60.83 | **TPER** | 79.82 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Daniel Goddard | **Assessor ID** | CP52-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Built)  (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) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (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 | | 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) = | 0.1611 | (8) |
| Pressure test | | | Yes | |
| Pressure Test Method | | | Blower Door | |
| Measured/design AP50 | | | 2.6400 | (17) |
| Infiltration rate | | | 0.2931 | (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) = | 0.2491 | (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 | 0.3176 | 0.3114 | 0.3052 | 0.2740 | 0.2678 | 0.2367 | 0.2367 | 0.2304 | 0.2491 | 0.2678 | 0.2803 | 0.2927 | (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 | 0.5504 | 0.5485 | 0.5466 | 0.5376 | 0.5359 | 0.5280 | 0.5280 | 0.5266 | 0.5310 | 0.5359 | 0.5393 | 0.5428 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Door | | | 2.1500 | 0.7800 | 1.6770 | | | (26) |
| Window | | | 5.7300 | 0.7282 | 4.1723 | | | (27) |
| GF | | | 3.0200 | 0.0900 | 0.2718 | 75.0000 | 226.5000 | (28a) |
| Exposed Floor | | | 1.6100 | 0.1400 | 0.2254 | 20.0000 | 32.2000 | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1300 | 7.7236 | 9.0000 | 534.7089 | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | 9.0000 | 412.6500 | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1200 | 0.3624 | 9.0000 | 27.1800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.4760 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | 20.0000 | 533.0000 | (32) |
| Party Floor 1 | | | 37.9700 | | | 30.0000 | 1139.1000 | (32d) |
| Timber | | | 50.4000 | | | 9.0000 | 453.6000 | (32c) |
| Internal Floor 1 | | | 6.2700 | | | 18.0000 | 112.8600 | (32d) |
| Heat capacity Cm = Sum(A x k) | | | | | (28)...(30) + (32) + (32a)...(32e) = | | 3471.7989 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 71.0415 | (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E2 | Other lintels (including other steel lintels) | 5.8000 | 0.1150 | 0.6670 |
| E3 | Sill | 5.8000 | 0.0170 | 0.0986 |
| E4 | Jamb | 16.2000 | 0.0940 | 1.5228 |
| E5 | Ground floor (normal) | 2.0100 | 0.0670 | 0.1347 |
| E7 | Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0320 | 0.6992 |
| E16 | Corner (normal) | 10.0800 | 0.0680 | 0.6854 |
| E17 | Corner (inverted - internal area greater than external area) | 5.0400 | -0.0290 | -0.1462 |
| P1 | Party wall - Ground floor | 5.1000 | 0.0560 | 0.2856 |
| E18 | Party wall between dwellings | 11.4000 | 0.2400 | 2.7360 |
| E25 | Staggered party wall between dwellings | 5.0400 | 0.0560 | 0.2822 |
| E20 | Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 | Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 | Intermediate floor within a dwelling | 2.5800 | 0.0320 | 0.0826 |
| E10 | Eaves (insulation at ceiling level) | 15.9700 | 0.0420 | 0.6707 |
| E12 | Gable (insulation at ceiling level) | 8.4600 | 0.0770 | 0.6514 |
| E14 | Flat roof | 2.0100 | 0.2050 | 0.4120 |
| E24 | Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.1500 | 0.3015 |
| P4 | Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1020 | 0.5008 |
| P5 | Party wall - Roof (insulation at rafter level) | 3.0000 | 0.4800 | 1.4400 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6501 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.1261 (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 | 22.5514 | 22.4712 | 22.3925 | 22.0230 | 21.9539 | 21.6320 | 21.6320 | 21.5724 | 21.7560 | 21.9539 | 22.0937 | 22.2399 | (38) |
| Heat transfer coeff | 54.6775 | 54.5973 | 54.5186 | 54.1491 | 54.0799 | 53.7581 | 53.7581 | 53.6985 | 53.8821 | 54.0799 | 54.2198 | 54.3660 | (39) |

Average = Sum(39)m / 12 = 54.1487

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1188 | 1.1172 | 1.1156 | 1.1080 | 1.1066 | 1.1000 | 1.1000 | 1.0988 | 1.1026 | 1.1066 | 1.1095 | 1.1125 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1080 | |
| 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 1.6569 (42)

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

Average daily hot water use (litres/day) 49.5727 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 54.0831 | 52.6002 | 50.9809 | 48.9648 | 47.1665 | 45.2976 | 44.9088 | 46.5247 | 48.1822 | 50.1015 | 52.1355 | 54.0071 | (44) |
| Energy conte | 85.6544 | 74.9019 | 78.3557 | 67.0304 | 63.4952 | 55.6987 | 54.3133 | 57.6074 | 59.4135 | 67.9873 | 74.2766 | 84.5621 | (45) |

Energy content (annual) Total = Sum(45)m = 823.2965

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | | | | | | | | | | | |
| 72.8063 | 63.6666 | 66.6024 | 56.9758 | 53.9710 | 47.3439 | 46.1663 | 48.9663 | 50.5015 | 57.7892 | 63.1351 | 71.8778 | (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 | | | | | | | | | | | | |
| 72.8063 | 63.6666 | 66.6024 | 56.9758 | 53.9710 | 47.3439 | 46.1663 | 48.9663 | 50.5015 | 57.7892 | 63.1351 | 71.8778 | (64) |

Total per year (kWh/year) = Sum(64)m = 699.8020 (64)
12Total per year (kWh/year) 700 (64)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electric shower(s) | | | | | | | | | | | | |
| 41.6433 | 37.1046 | 40.5168 | 38.6647 | 39.3902 | 37.5744 | 38.8269 | 39.3902 | 38.6647 | 40.5168 | 39.7549 | 41.6433 | (64a) |

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 473.6907 (64a)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat gains from water heating, kWh/month | | | | | | | | | | | | |
| 28.6124 | 25.1928 | 26.7798 | 23.9101 | 23.3403 | 21.2296 | 21.2483 | 22.0891 | 22.2915 | 24.5765 | 25.7225 | 28.3803 | (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 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| 83.5900 | 92.5461 | 83.5900 | 86.3763 | 83.5900 | 86.3763 | 83.5900 | 83.5900 | 86.3763 | 83.5900 | 86.3763 | 83.5900 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| 144.2994 | 145.7968 | 142.0235 | 133.9905 | 123.8503 | 114.3199 | 107.9530 | 106.4556 | 110.2290 | 118.2620 | 128.4022 | 137.9326 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | (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) | | | | | | | | | | | | | |
| -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| 38.4575 | 37.4893 | 35.9943 | 33.2085 | 31.3713 | 29.4855 | 28.5595 | 29.6897 | 30.9605 | 33.0329 | 35.7257 | 38.1455 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| 314.2003 | 323.6855 | 309.4611 | 301.4286 | 286.6649 | 278.0351 | 267.9559 | 267.5886 | 275.4191 | 282.7382 | 298.3575 | 307.5214 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a | g Specific data | FF Specific data | Access factor | Gains W |
|---|---|---|---|---|---|---|

| | | | | W/m2 | or Table 6b | or Table 6c | Table 6d | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | | | 2.8600 | 10.6334 | 0.3800 | 0.0000 | 0.7700 | | | | 8.8984 | (74) |
| South | | | 2.0500 | 46.7521 | 0.3800 | 0.0000 | 0.7700 | | | | 28.0433 | (78) |
| West | | | 0.8200 | 19.6403 | 0.3800 | 0.0000 | 0.7700 | | | | 4.7123 | (80) |
| Solar gains | 41.6540 | 72.1513 | 102.5811 | 134.6775 | 158.5625 | 161.0216 | 153.7257 | 135.2141 | 113.5130 | 80.7182 | 50.0939 | 35.5253 (83) |
| Total gains | 355.8543 | 395.8368 | 412.0423 | 436.1061 | 445.2274 | 439.0566 | 421.6816 | 402.8027 | 388.9321 | 363.4564 | 348.4514 | 343.0467 (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 | 17.6378 | 17.6637 | 17.6892 | 17.8099 | 17.8326 | 17.9394 | 17.9394 | 17.9593 | 17.8981 | 17.8326 | 17.7866 | 17.7388 | |
| alpha | 2.1759 | 2.1776 | 2.1793 | 2.1873 | 2.1888 | 2.1960 | 2.1960 | 2.1973 | 2.1932 | 2.1888 | 2.1858 | 2.1826 | |
| util living area | 0.9173 | 0.8949 | 0.8676 | 0.8111 | 0.7271 | 0.6002 | 0.4788 | 0.5108 | 0.6712 | 0.8190 | 0.8911 | 0.9229 | (86) |
| MIT | 17.9962 | 18.3114 | 18.7798 | 19.4494 | 20.0777 | 20.5844 | 20.8212 | 20.7869 | 20.4291 | 19.6373 | 18.7220 | 17.9364 | (87) |
| Th 2 | 19.9855 | 19.9868 | 19.9881 | 19.9943 | 19.9954 | 20.0008 | 20.0008 | 20.0018 | 19.9987 | 19.9954 | 19.9931 | 19.9907 | (88) |
| util rest of house | 0.9081 | 0.8833 | 0.8521 | 0.7874 | 0.6890 | 0.5381 | 0.3915 | 0.4251 | 0.6153 | 0.7917 | 0.8771 | 0.9143 | (89) |
| MIT 2 | 17.2489 | 17.5580 | 18.0181 | 18.6705 | 19.2654 | 19.7217 | 19.9092 | 19.8873 | 19.5938 | 18.8613 | 17.9708 | 17.1936 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 17.5413 | 17.8528 | 18.3161 | 18.9752 | 19.5832 | 20.0592 | 20.2660 | 20.2392 | 19.9206 | 19.1649 | 18.2647 | 17.4842 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.5413 | 17.8528 | 18.3161 | 18.9752 | 19.5832 | 20.0592 | 20.2660 | 20.2392 | 19.9206 | 19.1649 | 18.2647 | 17.4842 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8789 | 0.8522 | 0.8206 | 0.7590 | 0.6714 | 0.5420 | 0.4160 | 0.4468 | 0.6104 | 0.7648 | 0.8467 | 0.8859 | (94) |
| Useful gains | 312.7565 | 337.3265 | 338.1133 | 331.0239 | 298.9221 | 237.9863 | 175.4200 | 179.9856 | 237.4156 | 277.9761 | 295.0385 | 303.9160 | (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 | 724.0012 | 707.1848 | 644.1984 | 545.5653 | 426.3219 | 293.4789 | 197.0783 | 206.1619 | 313.6281 | 463.1908 | 605.3474 | 722.2105 | (97) |
| Space heating kWh | 305.9660 | 248.5448 | 227.7274 | 154.4698 | 94.7854 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 137.7997 | 223.4224 | 311.2111 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1703.9266 | |
| 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 | 305.9660 | 248.5448 | 227.7274 | 154.4698 | 94.7854 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 137.7997 | 223.4224 | 311.2111 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1703.9266 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 34.8665 | (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 | 505.3263 | 397.8101 | 408.1088 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.6659 | 0.7333 | 0.7101 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 336.4808 | 291.7071 | 289.8041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 475.3690 | 457.0016 | 436.6295 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 99.9995 | 122.9791 | 109.2381 | 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 | 24.9999 | 30.7448 | 27.3095 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 83.0542 | (107) |
| Energy for space heating | | | | | | | | | | | | 34.8665 | (99) |
| Energy for space cooling | | | | | | | | | | | | 1.6995 | (108) |
| Total | | | | | | | | | | | | 36.5660 | (109) |
| Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 36.6 | (109) |

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

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 | (1b) x | 2.8500 | (2b) = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 | (1c) x | 2.5200 | (2c) = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 124.1490 | (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 | 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) = | 0.1611 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4111 | (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) = | 0.3494 | (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 | 0.4455 | 0.4368 | 0.4281 | 0.3844 | 0.3756 | 0.3320 | 0.3320 | 0.3232 | 0.3494 | 0.3756 | 0.3931 | 0.4106 | (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 | 0.5992 | 0.5954 | 0.5916 | 0.5739 | 0.5706 | 0.5551 | 0.5551 | 0.5522 | 0.5611 | 0.5706 | 0.5773 | 0.5843 | (25) |

---

## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| TER Opaque door | | | 2.1500 | 1.0000 | 2.1500 | | | (26) |
| TER Opening Type | | | 5.7300 | 1.1450 | 6.5611 | | | (27) |
| GF | | | 3.0200 | 0.1300 | 0.3926 | | | (28a) |
| Exposed Floor | | | 1.6100 | 0.1300 | 0.2093 | | | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1800 | 10.6942 | | | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | | | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1100 | 0.3322 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 25.3828 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | | | (32) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 71.0415 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.0500 | 0.2900 |
| E3 Sill | 5.8000 | 0.0500 | 0.2900 |
| E4 Jamb | 16.2000 | 0.0500 | 0.8100 |
| E5 Ground floor (normal) | 2.0100 | 0.1600 | 0.3216 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0700 | 1.5295 |
| E16 Corner (normal) | 10.0800 | 0.0900 | 0.9072 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0900 | -0.4536 |
| P1 Party wall - Ground floor | 5.1000 | 0.0800 | 0.4080 |
| E18 Party wall between dwellings | 11.4000 | 0.0600 | 0.6840 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0600 | 0.3024 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0000 | 0.0000 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0600 | 0.9582 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0600 | 0.5076 |
| E14 Flat roof | 2.0100 | 0.0800 | 0.1608 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.2400 | 0.4824 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1200 | 0.5892 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.0800 | 0.2400 |

| | | | |
|---|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 9.6529 | (36) |
| Point Thermal bridges | (36a) = | 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = | 35.0357 | (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 | 24.5506 | 24.3928 | 24.2380 | 23.5111 | 23.3751 | 22.7419 | 22.7419 | 22.6247 | 22.9858 | 23.3751 | 23.6502 | 23.9378 | (38) |
| Heat transfer coeff | 59.5864 | 59.4285 | 59.2737 | 58.5468 | 58.4108 | 57.7777 | 57.7777 | 57.6604 | 58.0216 | 58.4108 | 58.6859 | 58.9736 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 58.5462 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2193 | 1.2161 | 1.2129 | 1.1980 | 1.1952 | 1.1823 | 1.1823 | 1.1799 | 1.1873 | 1.1952 | 1.2009 | 1.2067 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1980 | |
| 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 | 1.6569 | (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 | 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |
| Hot water usage for other uses | 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 49.5727 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 54.0831 | 52.6002 | 50.9809 | 48.9648 | 47.1665 | 45.2976 | 44.9088 | 46.5247 | 48.1822 | 50.1015 | 52.1355 | 54.0071 | (44) |
| Energy conte | 85.6544 | 74.9019 | 78.3557 | 67.0304 | 63.4952 | 55.6987 | 54.3133 | 57.6074 | 59.4135 | 67.9873 | 74.2766 | 84.5621 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 823.2965 | |
| 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 | | | | | | | | | | | | | |
| | 72.8063 | 63.6666 | 66.6024 | 56.9758 | 53.9710 | 47.3439 | 46.1663 | 48.9663 | 50.5015 | 57.7892 | 63.1351 | 71.8778 | (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 | | | | | | | | | | | | | |
| | 72.8063 | 63.6666 | 66.6024 | 56.9758 | 53.9710 | 47.3439 | 46.1663 | 48.9663 | 50.5015 | 57.7892 | 63.1351 | 71.8778 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 699.8020 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 700 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 41.6433 | 37.1046 | 40.5168 | 38.6647 | 39.3902 | 37.5744 | 38.8269 | 39.3902 | 38.6647 | 40.5168 | 39.7549 | 41.6433 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 473.6907 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 28.6124 | 25.1928 | 26.7798 | 23.9101 | 23.3403 | 21.2296 | 21.2483 | 22.0891 | 22.2915 | 24.5765 | 25.7225 | 28.3803 | (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 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 81.2011 | 89.9012 | 81.2011 | 83.9078 | 81.2011 | 83.9078 | 81.2011 | 81.2011 | 83.9078 | 81.2011 | 83.9078 | 81.2011 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 144.2994 | 145.7968 | 142.0235 | 133.9905 | 123.8503 | 114.3199 | 107.9530 | 106.4556 | 110.2290 | 118.2620 | 128.4022 | 137.9326 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | (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) | | | | | | | | | | | | | |
| | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 38.4575 | 37.4893 | 35.9943 | 33.2085 | 31.3713 | 29.4855 | 28.5595 | 29.6897 | 30.9605 | 33.0329 | 35.7257 | 38.1455 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 311.8114 | 321.0406 | 307.0722 | 298.9601 | 284.2760 | 275.5665 | 265.5669 | 265.1997 | 272.9505 | 280.3493 | 295.8890 | 305.1325 | (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 | 2.8600 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 9.2941 | (74) |
| South | 2.0500 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 29.2905 | (78) |
| West | 0.8200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 4.9219 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 43.5065 | 75.3601 | 107.1433 | 140.6671 | 165.6143 | 168.1828 | 160.5625 | 141.2276 | 118.5614 | 84.3081 | 52.3218 | 37.1053 | (83) |
| Total gains | 355.3179 | 396.4007 | 414.2155 | 439.6272 | 449.8903 | 443.7493 | 426.1294 | 406.4273 | 391.5119 | 364.6573 | 348.2107 | 342.2377 | (84) |

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## 7. Mean internal temperature (heating season)

---

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 16.1847 | 16.2277 | 16.2701 | 16.4721 | 16.5104 | 16.6914 | 16.6914 | 16.7253 | 16.6212 | 16.5104 | 16.4330 | 16.3529 | |
| alpha | 2.0790 | 2.0818 | 2.0847 | 2.0981 | 2.1007 | 2.1128 | 2.1128 | 2.1150 | 2.1081 | 2.1007 | 2.0955 | 2.0902 | |
| util living area | | | | | | | | | | | | | |
| | 0.9211 | 0.8998 | 0.8736 | 0.8194 | 0.7388 | 0.6151 | 0.4955 | 0.5276 | 0.6858 | 0.8278 | 0.8963 | 0.9263 | (86) |
| MIT | 17.7209 | 18.0495 | 18.5502 | 19.2753 | 19.9544 | 20.5174 | 20.7853 | 20.7464 | 20.3440 | 19.4845 | 18.5083 | 17.6747 | (87) |
| Th 2 | 19.9046 | 19.9072 | 19.9097 | 19.9216 | 19.9238 | 19.9342 | 19.9342 | 19.9361 | 19.9302 | 19.9238 | 19.9193 | 19.9146 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9118 | 0.8881 | 0.8579 | 0.7952 | 0.6994 | 0.5498 | 0.4015 | 0.4359 | 0.6275 | 0.8001 | 0.8822 | 0.9176 | (89) |
| MIT 2 | 16.9298 | 17.2531 | 17.7461 | 18.4569 | 19.1021 | 19.6139 | 19.8268 | 19.8027 | 19.4696 | 18.6700 | 17.7172 | 16.8906 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 17.2393 | 17.5647 | 18.0607 | 18.7771 | 19.4356 | 19.9674 | 20.2018 | 20.1719 | 19.8117 | 18.9887 | 18.0267 | 17.1974 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.2393 | 17.5647 | 18.0607 | 18.7771 | 19.4356 | 19.9674 | 20.2018 | 20.1719 | 19.8117 | 18.9887 | 18.0267 | 17.1974 | (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 | 0.8814 | 0.8554 | 0.8243 | 0.7643 | 0.6790 | 0.5520 | 0.4268 | 0.4578 | 0.6203 | 0.7708 | 0.8503 | 0.8881 | (94) |
| Useful gains | 313.1660 | 339.0685 | 341.4491 | 335.9986 | 305.4558 | 244.9485 | 181.8629 | 186.0658 | 242.8458 | 281.0653 | 296.0725 | 303.9538 | (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 | | | | | | | | | | | | | |
| | 771.0083 | 752.6431 | 685.2451 | 578.2720 | 451.8407 | 310.1159 | 208.1042 | 217.4910 | 331.4015 | 489.9879 | 641.2445 | 766.5022 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 340.6347 | 277.9221 | 255.7842 | 174.4369 | 108.9104 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 155.4384 | 248.5239 | 344.1360 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1905.7867 | |
| 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 | | | | | | | | | | | | | |
| | 340.6347 | 277.9221 | 255.7842 | 174.4369 | 108.9104 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 155.4384 | 248.5239 | 344.1360 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1905.7867 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 38.9971 | (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 | 543.1103 | 427.5549 | 438.2194 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.6386 | 0.7066 | 0.6829 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 346.8051 | 302.1063 | 299.2727 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 483.5303 | 464.7668 | 443.3646 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 98.4421 | 121.0194 | 107.2044 | 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 | 24.6105 | 30.2548 | 26.8011 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling requirement | | | | | | | | | | | | 81.6665 | (107) |
| Energy for space heating | | | | | | | | | | | | 38.9971 | (99) |
| Energy for space cooling | | | | | | | | | | | | 1.6711 | (108) |
| Total | | | | | | | | | | | | 40.6682 | (109) |
| Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 40.7 | (109) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | 78449-20 | **Issued on Date** | 18/08/2025 |
| **Assessment Reference** | 001 | **Prop Type Ref** | Top Flat / End |
| **Property** | 10 Shepherd Street, MANCHESTER, M9 4QW | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 81 B | **DER** | 5.82 | **TER** | 15.12 |
| **Environmental** | 96 A | **% DER < TER** | | | 61.51 |
| **$CO_2$ Emissions (t/year)** | 0.27 | **DFEE** | 36.57 | **TFEE** | 40.67 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 10.09 |
| **% DPER < TPER** | 23.79 | **DPER** | 60.83 | **TPER** | 79.82 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Daniel Goddard | **Assessor ID** | CP52-0001 |
| **Client** | | | |

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

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (5) |

## 2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 2.6400 | (17) |
| Infiltration rate | | 0.1320 | (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) = | 0.1122 | (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 | 0.1431 | 0.1403 | 0.1374 | 0.1234 | 0.1206 | 0.1066 | 0.1066 | 0.1038 | 0.1122 | 0.1206 | 0.1262 | 0.1318 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2426 | 0.2397 | 0.2369 | 0.2229 | 0.2201 | 0.2061 | 0.2061 | 0.2033 | 0.2117 | 0.2201 | 0.2257 | 0.2313 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Door | | | 2.1500 | 0.7800 | 1.6770 | | | (26) |
| Window | | | 5.7300 | 0.7282 | 4.1723 | | | (27) |
| GF | | | 3.0200 | 0.0900 | 0.2718 | 75.0000 | 226.5000 | (28a) |
| Exposed Floor | | | 1.6100 | 0.1400 | 0.2254 | 20.0000 | 32.2000 | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1300 | 7.7236 | 9.0000 | 534.7089 | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | 9.0000 | 412.6500 | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1200 | 0.3624 | 9.0000 | 27.1800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.4760 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | 20.0000 | 533.0000 | (32) |
| Party Floor 1 | | | 37.9700 | | | 30.0000 | 1139.1000 | (32d) |
| Timber | | | 50.4000 | | | 9.0000 | 453.6000 | (32c) |
| Internal Floor 1 | | | 6.2700 | | | 18.0000 | 112.8600 | (32d) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 3471.7989 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 71.0415 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.1150 | 0.6670 |
| E3 Sill | 5.8000 | 0.0170 | 0.0986 |
| E4 Jamb | 16.2000 | 0.0940 | 1.5228 |
| E5 Ground floor (normal) | 2.0100 | 0.0670 | 0.1347 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0320 | 0.6992 |
| E16 Corner (normal) | 10.0800 | 0.0680 | 0.6854 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0290 | -0.1462 |
| P1 Party wall - Ground floor | 5.1000 | 0.0560 | 0.2856 |
| E18 Party wall between dwellings | 11.4000 | 0.2400 | 2.7360 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0560 | 0.2822 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0320 | 0.0826 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0420 | 0.6707 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0770 | 0.6514 |
| E14 Flat roof | 2.0100 | 0.2050 | 0.4120 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.1500 | 0.3015 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1020 | 0.5008 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.4800 | 1.4400 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6501 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.1261 (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 | 9.9373 | 9.8224 | 9.7074 | 9.1328 | 9.0179 | 8.4433 | 8.4433 | 8.3284 | 8.6732 | 9.0179 | 9.2478 | 9.4776 | (38) |
| Heat transfer coeff | 42.0634 | 41.9484 | 41.8335 | 41.2589 | 41.1440 | 40.5694 | 40.5694 | 40.4545 | 40.7993 | 41.1440 | 41.3738 | 41.6037 | (39) |

Average = Sum(39)m / 12 = 41.2302

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8607 | 0.8584 | 0.8560 | 0.8443 | 0.8419 | 0.8301 | 0.8301 | 0.8278 | 0.8349 | 0.8419 | 0.8466 | 0.8513 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8437 | |
| 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 1.6569 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

Average daily hot water use (litres/day) 97.5150 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 200.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.6100 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.8694 | (55) |
| Total storage loss | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (56) |
| If cylinder contains dedicated solar storage | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (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 | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (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 | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1937.0342 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1937 | (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 | 55.8632 | 49.1556 | 51.6461 | 44.0910 | 41.8334 | 36.7136 | 35.5441 | 37.5210 | 38.5537 | 44.1619 | 48.3826 | 55.0851 | (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 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 83.5900 | 92.5461 | 83.5900 | 86.3763 | 83.5900 | 86.3763 | 83.5900 | 83.5900 | 86.3763 | 83.5900 | 86.3763 | 83.5900 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 144.2994 | 145.7968 | 142.0235 | 133.9905 | 123.8503 | 114.3199 | 107.9530 | 106.4556 | 110.2290 | 118.2620 | 128.4022 | 137.9326 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | (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) | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | 75.0850 | 73.1483 | 69.4168 | 61.2375 | 56.2277 | 50.9911 | 47.7744 | 50.4314 | 53.5468 | 59.3573 | 67.1981 | 74.0392 | (72) |
| Total internal gains | 350.8277 | 359.3444 | 342.8835 | 329.4576 | 311.5213 | 299.5406 | 287.1707 | 288.3304 | 298.0054 | 309.0626 | 329.8299 | 343.4150 | (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 | 2.8600 | 10.6334 | 0.3800 | 0.0000 | 0.7700 | 8.8984 | (74) |
| South | 2.0500 | 46.7521 | 0.3800 | 0.0000 | 0.7700 | 28.0433 | (78) |
| West | 0.8200 | 19.6403 | 0.3800 | 0.0000 | 0.7700 | 4.7123 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 41.6540 | 72.1513 | 102.5811 | 134.6775 | 158.5625 | 161.0216 | 153.7257 | 135.2141 | 113.5130 | 80.7182 | 50.0939 | 35.5253 | (83) |
| Total gains | 392.4818 | 431.4958 | 445.4647 | 464.1351 | 470.0837 | 460.5622 | 440.8964 | 423.5445 | 411.5184 | 389.7808 | 379.9238 | 378.9404 | (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 | 22.9270 | 22.9899 | 23.0530 | 23.3741 | 23.4393 | 23.7713 | 23.7713 | 23.8388 | 23.6374 | 23.4393 | 23.3091 | 23.1804 | |
| alpha | 2.5285 | 2.5327 | 2.5369 | 2.5583 | 2.5626 | 2.5848 | 2.5848 | 2.5893 | 2.5758 | 2.5626 | 2.5539 | 2.5454 | |
| util living area | 0.8838 | 0.8539 | 0.8173 | 0.7446 | 0.6420 | 0.4996 | 0.3806 | 0.4085 | 0.5747 | 0.7520 | 0.8473 | 0.8912 | (86) |
| MIT | 18.9551 | 19.2329 | 19.6023 | 20.1096 | 20.5309 | 20.8276 | 20.9377 | 20.9235 | 20.7378 | 20.2178 | 19.5340 | 18.9132 | (87) |
| Th 2 | 20.2010 | 20.2030 | 20.2050 | 20.2151 | 20.2172 | 20.2273 | 20.2273 | 20.2293 | 20.2232 | 20.2172 | 20.2131 | 20.2091 | (88) |
| util rest of house | 0.8733 | 0.8411 | 0.8008 | 0.7211 | 0.6077 | 0.4514 | 0.3205 | 0.3481 | 0.5278 | 0.7247 | 0.8320 | 0.8813 | (89) |
| MIT 2 | 17.7947 | 18.1417 | 18.6031 | 19.2320 | 19.7349 | 20.0744 | 20.1834 | 20.1733 | 19.9795 | 19.3741 | 18.5307 | 17.7476 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 18.2487 | 18.5686 | 18.9940 | 19.5753 | 20.0464 | 20.3691 | 20.4785 | 20.4668 | 20.2762 | 19.7042 | 18.9232 | 18.2036 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.2487 | 18.5686 | 18.9940 | 19.5753 | 20.0464 | 20.3691 | 20.4785 | 20.4668 | 20.2762 | 19.7042 | 18.9232 | 18.2036 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8420 | 0.8099 | 0.7720 | 0.6999 | 0.5997 | 0.4605 | 0.3405 | 0.3672 | 0.5312 | 0.7049 | 0.8024 | 0.8505 | (94) |
| Useful gains | 330.4567 | 349.4810 | 343.8769 | 324.8445 | 281.9323 | 212.1001 | 150.1119 | 155.5234 | 218.5885 | 274.7413 | 304.8530 | 322.2875 | (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 | 586.7290 | 573.3759 | 522.6701 | 440.4520 | 343.4032 | 234.0487 | 157.3476 | 164.5214 | 251.9842 | 374.5833 | 489.1722 | 582.6019 | (97) |
| Space heating kWh | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1003.7841 | |
| 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 | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1003.7841 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 20.5399 | (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) |
| Fraction of main heating from main system 2 | 0.0000 | (203) |
| Fraction of total heating from main system 1 | 1.0000 | (204) |
| Fraction of total heating from main system 2 | 0.0000 | (205) |
| Efficiency of main space heating system 1 (in %) | 100.0000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 190.6666 | 150.4574 | 133.0222 | 83.2374 | 45.7343 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 74.2824 | 132.7098 | 193.6739 | (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) |
| Space heating fuel used, main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 324.5200 | (216) |
| (217)m | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | (217) |
| Fuel for water heating, kWh/month | 60.0768 | 53.0567 | 56.1685 | 48.8988 | 47.0745 | 42.0617 | 41.2458 | 43.0779 | 43.7671 | 49.2324 | 52.8761 | 59.3557 | (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 | 15.6682 | 14.1519 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | (231) |
| Lighting | 16.7415 | 13.4307 | 12.0928 | 8.8597 | 6.8435 | 5.5912 | 6.2429 | 8.1147 | 10.5402 | 13.8293 | 15.6202 | 17.2068 | (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 | 1003.7841 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 324.5200 | |
| Water heating fuel used | 596.8921 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2180) | | |
| mechanical ventilation fans (SFP = 1.2180) | 184.4804 | (230a) |
| Total electricity for the above, kWh/year | 184.4804 | (231) |
| Electricity for lighting (calculated in Appendix L) | 135.1135 | (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 | 1920.2701 | (238) |

---

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 | 1003.7841 | 0.1546 | 155.1546 | (261) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (262) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 596.8921 | 0.1411 | 84.2266 | (264) |
| Space and water heating | | | 239.3812 | (265) |
| Pumps, fans and electric keep-hot | 184.4804 | 0.1387 | 25.5897 | (267) |
| Energy for lighting | 135.1135 | 0.1443 | 19.5011 | (268) |
| Total CO2, kg/year | | | 284.4719 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 5.8200 | (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 | 1003.7841 | 1.5723 | 1578.2011 | (275) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (276) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 1.5218 | 908.3378 | (278) |
| Space and water heating | | | 2486.5389 | (279) |
| Pumps, fans and electric keep-hot | 184.4804 | 1.5128 | 279.0820 | (281) |
| Energy for lighting | 135.1135 | 1.5338 | 207.2416 | (282) |
| Total Primary energy kWh/year | | | 2972.8625 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 60.8300 | (287) |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (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 | 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) = | 0.1611 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |

| | | |
|---|---|---|
| Infiltration rate | | 0.4111 (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) = | 0.3494 (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 | 0.4455 | 0.4368 | 0.4281 | 0.3844 | 0.3756 | 0.3320 | 0.3320 | 0.3232 | 0.3494 | 0.3756 | 0.3931 | 0.4106 | (22b) |
| Effective ac | 0.5992 | 0.5954 | 0.5916 | 0.5739 | 0.5706 | 0.5551 | 0.5551 | 0.5522 | 0.5611 | 0.5706 | 0.5773 | 0.5843 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.1500 | 1.0000 | 2.1500 | | | (26) |
| TER Opening Type | | | 5.7300 | 1.1450 | 6.5611 | | | (27) |
| GF | | | 3.0200 | 0.1300 | 0.3926 | | | (28a) |
| Exposed Floor | | | 1.6100 | 0.1300 | 0.2093 | | | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1800 | 10.6942 | | | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | | | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1100 | 0.3322 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 25.3828 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | | | (32) |

| | |
|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 71.0415 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.0500 | 0.2900 |
| E3 Sill | 5.8000 | 0.0500 | 0.2900 |
| E4 Jamb | 16.2000 | 0.0500 | 0.8100 |
| E5 Ground floor (normal) | 2.0100 | 0.1600 | 0.3216 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0700 | 1.5295 |
| E16 Corner (normal) | 10.0800 | 0.0900 | 0.9072 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0900 | -0.4536 |
| P1 Party wall - Ground floor | 5.1000 | 0.0800 | 0.4080 |
| E18 Party wall between dwellings | 11.4000 | 0.0600 | 0.6840 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0600 | 0.3024 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0000 | 0.0000 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0600 | 0.9582 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0600 | 0.5076 |
| E14 Flat roof | 2.0100 | 0.0800 | 0.1608 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.2400 | 0.4824 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1200 | 0.5892 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.0800 | 0.2400 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 9.6529 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 35.0357 (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 | 24.5506 | 24.3928 | 24.2380 | 23.5111 | 23.3751 | 22.7419 | 22.7419 | 22.6247 | 22.9858 | 23.3751 | 23.6502 | 23.9378 | (38) |
| Heat transfer coeff | 59.5864 | 59.4285 | 59.2737 | 58.5468 | 58.4108 | 57.7777 | 57.7777 | 57.6604 | 58.0216 | 58.4108 | 58.6859 | 58.9736 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 58.5462 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.2193 | 1.2161 | 1.2129 | 1.1980 | 1.1952 | 1.1823 | 1.1823 | 1.1799 | 1.1873 | 1.1952 | 1.2009 | 1.2067 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1980 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | |
|---|---|
| Assumed occupancy | 1.6569 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

| | |
|---|---|
| Average daily hot water use (litres/day) | 97.5150 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |

| | |
|---|---|
| Water storage loss: | |
| Store volume | 150.0000 (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 (48) |
| Temperature factor from Table 2b | 0.5400 (49) |
| Enter (49) or (54) in (55) | 0.7527 (55) |

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 214.6047 | 189.9222 | 201.9214 | 177.6964 | 172.4096 | 155.5086 | 153.4945 | 159.4400 | 161.0427 | 179.4125 | 190.6035 | 212.2645 | (62) |
| WWHRS | -23.7722 | -21.0244 | -22.0155 | -18.2297 | -16.9894 | -14.5380 | -13.6270 | -14.4910 | -15.0415 | -17.7323 | -20.0886 | -23.3320 | (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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 190.8324 | 168.8978 | 179.9059 | 159.4667 | 155.4202 | 140.9706 | 139.8675 | 144.9490 | 146.0012 | 161.6802 | 170.5149 | 188.9325 | (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | 1947.4390 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1947 | (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 | | | | | | | | | | | | | |
| | 93.1392 | 82.8242 | 88.9220 | 80.1645 | 79.1093 | 72.7870 | 72.8200 | 74.7969 | 74.6271 | 81.4378 | 84.4561 | 92.3611 | (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 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | 82.8443 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 81.2011 | 89.9012 | 81.2011 | 83.9078 | 81.2011 | 83.9078 | 81.2011 | 81.2011 | 83.9078 | 81.2011 | 83.9078 | 81.2011 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 144.2994 | 145.7968 | 142.0235 | 133.9905 | 123.8503 | 114.3199 | 107.9530 | 106.4556 | 110.2290 | 118.2620 | 128.4022 | 137.9326 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | 31.2844 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 125.1871 | 123.2503 | 119.5188 | 111.3395 | 106.3297 | 101.0931 | 97.8764 | 100.5335 | 103.6488 | 109.4594 | 117.3001 | 124.1412 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 401.5409 | 409.8016 | 393.5967 | 380.0911 | 362.2344 | 347.1741 | 334.8838 | 336.0435 | 345.6389 | 359.7758 | 380.4634 | 394.1282 | (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 | 2.8600 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 9.2941 | (74) |
| South | 2.0500 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 29.2905 | (78) |
| West | 0.8200 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 4.9219 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 43.5065 | 75.3601 | 107.1433 | 140.6671 | 165.6143 | 168.1828 | 160.5625 | 141.2276 | 118.5614 | 84.3081 | 52.3218 | 37.1053 | (83) |
| Total gains | 445.0474 | 485.1618 | 500.7400 | 520.7582 | 527.8487 | 515.3569 | 495.4463 | 477.2711 | 464.2003 | 444.0838 | 432.7852 | 431.2334 | (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 | 16.1847 | 16.2277 | 16.2701 | 16.4721 | 16.5104 | 16.6914 | 16.6914 | 16.7253 | 16.6212 | 16.5104 | 16.4330 | 16.3529 | |
| alpha | 2.0790 | 2.0818 | 2.0847 | 2.0981 | 2.1007 | 2.1128 | 2.1128 | 2.1150 | 2.1081 | 2.1007 | 2.0955 | 2.0902 | |
| util living area | | | | | | | | | | | | | |
| | 0.8867 | 0.8632 | 0.8331 | 0.7740 | 0.6872 | 0.5615 | 0.4434 | 0.4709 | 0.6269 | 0.7759 | 0.8553 | 0.8925 | (86) |
| MIT | 18.0516 | 18.3549 | 18.8226 | 19.4876 | 20.1049 | 20.5991 | 20.8277 | 20.7978 | 20.4560 | 19.6963 | 18.7955 | 18.0098 | (87) |
| Th 2 | 19.9046 | 19.9072 | 19.9097 | 19.9216 | 19.9238 | 19.9342 | 19.9342 | 19.9361 | 19.9302 | 19.9238 | 19.9193 | 19.9146 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8743 | 0.8484 | 0.8141 | 0.7464 | 0.6451 | 0.4964 | 0.3547 | 0.3836 | 0.5667 | 0.7436 | 0.8373 | 0.8807 | (89) |
| MIT 2 | 16.5191 | 16.8959 | 17.4784 | 18.2996 | 19.0385 | 19.6007 | 19.8266 | 19.8036 | 19.4523 | 18.5667 | 17.4573 | 16.4706 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3912 | (91) |
| MIT | 17.1187 | 17.4667 | 18.0043 | 18.7644 | 19.4557 | 19.9913 | 20.2183 | 20.1926 | 19.8450 | 19.0086 | 17.9809 | 17.0728 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.1187 | 17.4667 | 18.0043 | 18.7644 | 19.4557 | 19.9913 | 20.2183 | 20.1926 | 19.8450 | 19.0086 | 17.9809 | 17.0728 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8325 | 0.8059 | 0.7728 | 0.7115 | 0.6245 | 0.5001 | 0.3797 | 0.4060 | 0.5614 | 0.7109 | 0.7963 | 0.8396 | (94) |
| Useful gains | 370.4933 | 390.9897 | 386.9657 | 370.5384 | 329.6269 | 257.7521 | 188.1079 | 193.7498 | 260.5952 | 315.7120 | 344.6092 | 362.0700 | (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 | | | | | | | | | | | | | |
| | 763.8196 | 746.8206 | 681.9015 | 577.5299 | 453.0180 | 311.4968 | 209.0571 | 218.6804 | 333.3343 | 491.1537 | 638.5562 | 759.1545 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 292.6348 | 239.1184 | 219.4322 | 149.0339 | 91.8029 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.5286 | 211.6418 | 295.4309 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1629.6235 | |
| 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 | | | | | | | | | | | | | |
| | 292.6348 | 239.1184 | 219.4322 | 149.0339 | 91.8029 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.5286 | 211.6418 | 295.4309 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1629.6235 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 33.3461 | (99) |

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

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 292.6348 | 239.1184 | 219.4322 | 149.0339 | 91.8029 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.5286 | 211.6418 | 295.4309 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 317.0474 | 259.0665 | 237.7380 | 161.4668 | 99.4615 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 141.4178 | 229.2977 | 320.0768 (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 | | | | | | | | | | | | |
| | 190.8324 | 168.8978 | 179.9059 | 159.4667 | 155.4202 | 140.9706 | 139.8675 | 144.9490 | 146.0012 | 161.6802 | 170.5149 | 188.9325 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.0154 | 84.8392 | 84.5063 | 83.9083 | 82.9208 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.5841 | 84.5455 | 85.0581 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 224.4681 | 199.0799 | 212.8906 | 190.0487 | 187.4322 | 176.6549 | 175.2725 | 181.6404 | 182.9589 | 193.4341 | 201.6842 | 222.1216 (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 | 16.8720 | 13.5353 | 12.1871 | 8.9288 | 6.8968 | 5.6348 | 6.2915 | 8.1780 | 10.6224 | 13.9371 | 15.7419 | 17.3409 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -23.3618 | -33.1899 | -48.0847 | -54.5349 | -59.2499 | -55.5210 | -54.9018 | -51.6559 | -45.9280 | -38.2405 | -25.7999 | -20.1733 (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 | -12.4159 | -26.2127 | -52.2550 | -78.6854 | -104.2042 | -104.7074 | -103.4098 | -87.4228 | -63.9461 | -37.4757 | -16.5791 | -9.8055 (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 | 1765.5726 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2347.6863 (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) | 136.1665 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -1207.7611 (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 | 3127.6643 (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 | 1765.5726 | 0.2100 | 370.7702 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2347.6863 | 0.2100 | 493.0141 | (264) |
| Space and water heating | | | 863.7844 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 136.1665 | 0.1443 | 19.6530 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -510.6416 | 0.1344 | -68.6248 | |
| PV Unit electricity exported | -697.1195 | 0.1258 | -87.7220 | |
| Total | | | -156.3468 | (269) |
| Total CO2, kg/year | | | 739.0198 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.1200 | (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 | 1765.5726 | 1.1300 | 1995.0970 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2347.6863 | 1.1300 | 2652.8855 | (278) |
| Space and water heating | | | 4647.9825 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 136.1665 | 1.5338 | 208.8568 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -510.6416 | 1.4967 | -764.2616 | |
| PV Unit electricity exported | -697.1195 | 0.4619 | -321.9990 | |
| Total | | | -1086.2606 | (283) |
| Total Primary energy kWh/year | | | 3900.6795 | (286) |
| Target Primary Energy Rate (TPER) | | | 79.8200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Property Reference** | 78449-20 | **Issued on Date** | 18/08/2025 |
| **Assessment Reference** | 001 | **Prop Type Ref** | Top Flat / End |
| **Property** | 10 Shepherd Street, MANCHESTER, M9 4QW | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 81 B | **DER** | 5.82 | **TER** | 15.12 |
| **Environmental** | 96 A | **% DER < TER** | | | 61.51 |
| **$CO_2$ Emissions (t/year)** | 0.27 | **DFEE** | 36.57 | **TFEE** | 40.67 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 10.09 |
| **% DPER < TPER** | 23.79 | **DPER** | 60.83 | **TPER** | 79.82 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Daniel Goddard | **Assessor ID** | CP52-0001 |
| **Client** | | | |

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

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (5) |

## 2. Ventilation rate

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

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 2.6400 | (17) |
| Infiltration rate | | 0.1320 | (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) = | 0.1122 | (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 | 0.1431 | 0.1403 | 0.1374 | 0.1234 | 0.1206 | 0.1066 | 0.1066 | 0.1038 | 0.1122 | 0.1206 | 0.1262 | 0.1318 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2426 | 0.2397 | 0.2369 | 0.2229 | 0.2201 | 0.2061 | 0.2061 | 0.2033 | 0.2117 | 0.2201 | 0.2257 | 0.2313 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Door | | | 2.1500 | 0.7800 | 1.6770 | | | (26) |
| Window | | | 5.7300 | 0.7282 | 4.1723 | | | (27) |
| GF | | | 3.0200 | 0.0900 | 0.2718 | 75.0000 | 226.5000 | (28a) |
| Exposed Floor | | | 1.6100 | 0.1400 | 0.2254 | 20.0000 | 32.2000 | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1300 | 7.7236 | 9.0000 | 534.7089 | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | 9.0000 | 412.6500 | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1200 | 0.3624 | 9.0000 | 27.1800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.4760 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | 20.0000 | 533.0000 | (32) |
| Party Floor 1 | | | 37.9700 | | | 30.0000 | 1139.1000 | (32d) |
| Timber | | | 50.4000 | | | 9.0000 | 453.6000 | (32c) |
| Internal Floor 1 | | | 6.2700 | | | 18.0000 | 112.8600 | (32d) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 3471.7989 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 71.0415 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.1150 | 0.6670 |
| E3 Sill | 5.8000 | 0.0170 | 0.0986 |
| E4 Jamb | 16.2000 | 0.0940 | 1.5228 |
| E5 Ground floor (normal) | 2.0100 | 0.0670 | 0.1347 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0320 | 0.6992 |
| E16 Corner (normal) | 10.0800 | 0.0680 | 0.6854 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0290 | -0.1462 |
| P1 Party wall - Ground floor | 5.1000 | 0.0560 | 0.2856 |
| E18 Party wall between dwellings | 11.4000 | 0.2400 | 2.7360 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0560 | 0.2822 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0320 | 0.0826 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0420 | 0.6707 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0770 | 0.6514 |
| E14 Flat roof | 2.0100 | 0.2050 | 0.4120 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.1500 | 0.3015 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1020 | 0.5008 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.4800 | 1.4400 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6501 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.1261 (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 | 9.9373 | 9.8224 | 9.7074 | 9.1328 | 9.0179 | 8.4433 | 8.4433 | 8.3284 | 8.6732 | 9.0179 | 9.2478 | 9.4776 | (38) |
| Heat transfer coeff | 42.0634 | 41.9484 | 41.8335 | 41.2589 | 41.1440 | 40.5694 | 40.5694 | 40.4545 | 40.7993 | 41.1440 | 41.3738 | 41.6037 | (39) |

Average = Sum(39)m / 12 = 41.2302

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8607 | 0.8584 | 0.8560 | 0.8443 | 0.8419 | 0.8301 | 0.8301 | 0.8278 | 0.8349 | 0.8419 | 0.8466 | 0.8513 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8437 | |
| 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 1.6569 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

Average daily hot water use (litres/day) 97.5150 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6100 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8694 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1937.0342 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55.8632 | 49.1556 | 51.6461 | 44.0910 | 41.8334 | 36.7136 | 35.5441 | 37.5210 | 38.5537 | 44.1619 | 48.3826 | 55.0851 | (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 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 19.1267 | 16.9882 | 13.8157 | 10.4594 | 7.8185 | 6.6007 | 7.1323 | 9.2708 | 12.4433 | 15.7996 | 18.4405 | 19.6583 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 215.3723 | 217.6072 | 211.9753 | 199.9858 | 184.8511 | 170.6267 | 161.1239 | 158.8890 | 164.5209 | 176.5104 | 191.6451 | 205.8695 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | (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) | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | 75.0850 | 73.1483 | 69.4168 | 61.2375 | 56.2277 | 50.9911 | 47.7744 | 50.4314 | 53.5468 | 59.3573 | 67.1981 | 74.0392 | (72) |
| Total internal gains | 389.3200 | 387.4796 | 374.9438 | 351.4186 | 328.6333 | 307.9544 | 295.7665 | 298.3273 | 310.2469 | 331.4033 | 357.0196 | 379.3029 | (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 | 2.8600 | 10.6334 | 0.3800 | 0.0000 | 0.7700 | 8.8984 | (74) |
| South | 2.0500 | 46.7521 | 0.3800 | 0.0000 | 0.7700 | 28.0433 | (78) |
| West | 0.8200 | 19.6403 | 0.3800 | 0.0000 | 0.7700 | 4.7123 | (80) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 41.6540 | 72.1513 | 102.5811 | 134.6775 | 158.5625 | 161.0216 | 153.7257 | 135.2141 | 113.5130 | 80.7182 | 50.0939 | 35.5253 | (83) |
| Total gains | 430.9740 | 459.6309 | 477.5249 | 486.0961 | 487.1958 | 468.9760 | 449.4922 | 433.5414 | 423.7599 | 412.1216 | 407.1135 | 414.8282 | (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 | 22.9270 | 22.9899 | 23.0530 | 23.3741 | 23.4393 | 23.7713 | 23.7713 | 23.8388 | 23.6374 | 23.4393 | 23.3091 | 23.1804 | |
| alpha | 2.5285 | 2.5327 | 2.5369 | 2.5583 | 2.5626 | 2.5848 | 2.5848 | 2.5893 | 2.5758 | 2.5626 | 2.5539 | 2.5454 | |
| util living area | 0.8632 | 0.8378 | 0.7969 | 0.7285 | 0.6281 | 0.4927 | 0.3743 | 0.4004 | 0.5631 | 0.7327 | 0.8290 | 0.8722 | (86) |
| MIT | 19.0997 | 19.3287 | 19.6970 | 20.1588 | 20.5554 | 20.8333 | 20.9401 | 20.9270 | 20.7503 | 20.2691 | 19.6244 | 19.0523 | (87) |
| Th 2 | 20.2010 | 20.2030 | 20.2050 | 20.2151 | 20.2172 | 20.2273 | 20.2273 | 20.2293 | 20.2232 | 20.2172 | 20.2131 | 20.2091 | (88) |
| util rest of house | 0.8514 | 0.8241 | 0.7793 | 0.7043 | 0.5937 | 0.4448 | 0.3149 | 0.3409 | 0.5165 | 0.7045 | 0.8126 | 0.8611 | (89) |
| MIT 2 | 17.9731 | 18.2589 | 18.7171 | 19.2891 | 19.7614 | 20.0796 | 20.1852 | 20.1760 | 19.9918 | 19.4328 | 18.6400 | 17.9196 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 18.4139 | 18.6774 | 19.1005 | 19.6294 | 20.0720 | 20.3745 | 20.4805 | 20.4698 | 20.2886 | 19.7600 | 19.0251 | 18.3628 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.4139 | 18.6774 | 19.1005 | 19.6294 | 20.0720 | 20.3745 | 20.4805 | 20.4698 | 20.2886 | 19.7600 | 19.0251 | 18.3628 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8199 | 0.7934 | 0.7517 | 0.6846 | 0.5869 | 0.4542 | 0.3348 | 0.3599 | 0.5206 | 0.6865 | 0.7838 | 0.8298 | (94) |
| Useful gains | 353.3502 | 364.6787 | 358.9728 | 332.7727 | 285.9323 | 213.0049 | 150.4744 | 156.0530 | 220.5931 | 282.9069 | 319.0759 | 344.2287 | (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 | 593.6772 | 577.9418 | 527.1234 | 442.6831 | 344.4594 | 234.2669 | 157.4304 | 164.6434 | 252.4883 | 376.8784 | 493.3892 | 589.2246 | (97) |
| Space heating kWh | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 947.5971 | |
| 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 | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 947.5971 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 19.3902 | (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) |
| Fraction of main heating from main system 2 | 0.0000 (203) |
| Fraction of total heating from main system 1 | 1.0000 (204) |
| Fraction of total heating from main system 2 | 0.0000 (205) |
| Efficiency of main space heating system 1 (in %) | 100.0000 (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (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) |
| Space heating fuel used, main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 324.5200 | (216) |
| (217)m | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | (217) |
| Fuel for water heating, kWh/month | 60.0768 | 53.0567 | 56.1685 | 48.8988 | 47.0745 | 42.0617 | 41.2458 | 43.0779 | 43.7671 | 49.2324 | 52.8761 | 59.3557 | (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 | 15.6682 | 14.1519 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | (231) |
| Lighting | 16.7415 | 13.4307 | 12.0928 | 8.8597 | 6.8435 | 5.5912 | 6.2429 | 8.1147 | 10.5402 | 13.8293 | 15.6202 | 17.2068 | (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 | 947.5971 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 324.5200 | |
| Water heating fuel used | 596.8921 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2180) | | |
| mechanical ventilation fans (SFP = 1.2180) | 184.4804 | (230a) |
| Total electricity for the above, kWh/year | 184.4804 | (231) |
| Electricity for lighting (calculated in Appendix L) | 135.1135 | (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 | 1864.0831 | (238) |

---

10a. Fuel costs - using Table 12 prices

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| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 947.5971 | 16.4900 | 156.2588 | (240) |
| Space heating - main system 2 | 0.0000 | 16.4900 | 0.0000 | (241) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 16.4900 | 98.4275 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 16.4900 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 184.4804 | 16.4900 | 30.4208 | (249) |
| Energy for lighting | 135.1135 | 16.4900 | 22.2802 | (250) |
| Additional standing charges | | | 0.0000 | (251) |
| Total energy cost | | | 307.3873 | (255) |

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11a. SAP rating - Individual heating systems

---

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12): | | 0.3600 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] / [(4) + 45.0] = | 1.1789 | (257) |
| SAP value | | 80.8907 | |
| SAP rating (Section 12) | | 81 | (258) |
| SAP band | | B | |

---

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

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 947.5971 | 0.1545 | 146.4510 | (261) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (262) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 596.8921 | 0.1411 | 84.2266 | (264) |
| Space and water heating | | | 230.6776 | (265) |
| Pumps, fans and electric keep-hot | 184.4804 | 0.1387 | 25.5897 | (267) |
| Energy for lighting | 135.1135 | 0.1443 | 19.5011 | (268) |
| Total CO2, kg/year | | | 275.7684 | (272) |
| CO2 emissions per m2 | | | 5.6400 | (273) |
| EI value | | | 96.0634 | |
| EI rating | | | 96 | (274) |
| EI band | | | A | |

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

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 | (1b) x | 2.8500 | (2b) = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 | (1c) x | 2.5200 | (2c) = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 124.1490 | (5) |

---

2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |

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

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 2.6400 (17) |
| Infiltration rate | | 0.1320 (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) = | 0.1122 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 4.6000 | 4.5000 | 4.5000 | 4.1000 | 4.2000 | 3.7000 | 3.5000 | 3.5000 | 3.7000 | 4.1000 | 4.1000 | 4.2000 | (22) |
| Wind factor | 1.1500 | 1.1250 | 1.1250 | 1.0250 | 1.0500 | 0.9250 | 0.8750 | 0.8750 | 0.9250 | 1.0250 | 1.0250 | 1.0500 | (22a) |
| Adj infilt rate | 0.1290 | 0.1262 | 0.1262 | 0.1150 | 0.1178 | 0.1038 | 0.0982 | 0.0982 | 0.1038 | 0.1150 | 0.1150 | 0.1178 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2285 | 0.2257 | 0.2257 | 0.2145 | 0.2173 | 0.2033 | 0.1977 | 0.1977 | 0.2033 | 0.2145 | 0.2145 | 0.2173 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Door | | | 2.1500 | 0.7800 | 1.6770 | | | (26) |
| Window | | | 5.7300 | 0.7282 | 4.1723 | | | (27) |
| GF | | | 3.0200 | 0.0900 | 0.2718 | 75.0000 | 226.5000 | (28a) |
| Exposed Floor | | | 1.6100 | 0.1400 | 0.2254 | 20.0000 | 32.2000 | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1300 | 7.7236 | 9.0000 | 534.7089 | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | 9.0000 | 412.6500 | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1200 | 0.3624 | 9.0000 | 27.1800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.4760 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | 20.0000 | 533.0000 | (32) |
| Party Floor 1 | | | 37.9700 | | | 30.0000 | 1139.1000 | (32d) |
| Timber | | | 50.4000 | | | 9.0000 | 453.6000 | (32c) |
| Internal Floor 1 | | | 6.2700 | | | 18.0000 | 112.8600 | (32d) |

| | |
|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 3471.7989 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 71.0415 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.1150 | 0.6670 |
| E3 Sill | 5.8000 | 0.0170 | 0.0986 |
| E4 Jamb | 16.2000 | 0.0940 | 1.5228 |
| E5 Ground floor (normal) | 2.0100 | 0.0670 | 0.1347 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0320 | 0.6992 |
| E16 Corner (normal) | 10.0800 | 0.0680 | 0.6854 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0290 | -0.1462 |
| P1 Party wall - Ground floor | 5.1000 | 0.0560 | 0.2856 |
| E18 Party wall between dwellings | 11.4000 | 0.2400 | 2.7360 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0560 | 0.2822 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0320 | 0.0826 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0420 | 0.6707 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0770 | 0.6514 |
| E14 Flat roof | 2.0100 | 0.2050 | 0.4120 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.1500 | 0.3015 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1020 | 0.5008 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.4800 | 1.4400 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 12.6501 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 32.1261 (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 | 9.3627 | 9.2478 | 9.2478 | 8.7881 | 8.9030 | 8.3284 | 8.0986 | 8.0986 | 8.3284 | 8.7881 | 8.7881 | 8.9030 | (38) |
| Heat transfer coeff | 41.4888 | 41.3738 | 41.3738 | 40.9142 | 41.0291 | 40.4545 | 40.2247 | 40.2247 | 40.4545 | 40.9142 | 40.9142 | 41.0291 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 40.8663 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8490 | 0.8466 | 0.8466 | 0.8372 | 0.8396 | 0.8278 | 0.8231 | 0.8231 | 0.8278 | 0.8372 | 0.8372 | 0.8396 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8362 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | |
|---|---|---|
| Assumed occupancy | | 1.6569 (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |
| Hot water usage for baths | 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |
| Hot water usage for other uses | 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 97.5150 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 200.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.6100 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.8694 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (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 | | | | | | | | | | | | | |
| | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (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 | | | | | | | | | | | | | |
| | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1937.0342 | (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 | | | | | | | | | | | | | |
| | 55.8632 | 49.1556 | 51.6461 | 44.0910 | 41.8334 | 36.7136 | 35.5441 | 37.5210 | 38.5537 | 44.1619 | 48.3826 | 55.0851 | (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 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 19.1267 | 16.9882 | 13.8157 | 10.4594 | 7.8185 | 6.6007 | 7.1323 | 9.2708 | 12.4433 | 15.7996 | 18.4405 | 19.6583 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 215.3723 | 217.6072 | 211.9753 | 199.9858 | 184.8511 | 170.6267 | 161.1239 | 158.8890 | 164.5209 | 176.5104 | 191.6451 | 205.8695 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | (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) | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | 75.0850 | 73.1483 | 69.4168 | 61.2375 | 56.2277 | 50.9911 | 47.7744 | 50.4314 | 53.5468 | 59.3573 | 67.1981 | 74.0392 | (72) |
| Total internal gains | 389.3200 | 387.4796 | 374.9438 | 351.4186 | 328.6333 | 307.9544 | 295.7665 | 298.3273 | 310.2469 | 331.4033 | 357.0196 | 379.3029 | (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 | 2.8600 | 8.9975 | 0.3800 | 0.0000 | 0.7700 | 7.5294 | (74) |
| South | 2.0500 | 39.5594 | 0.3800 | 0.0000 | 0.7700 | 23.7289 | (78) |
| West | 0.8200 | 16.6187 | 0.3800 | 0.0000 | 0.7700 | 3.9874 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 35.2457 | 64.1345 | 96.1698 | 128.3926 | 147.8265 | 152.9705 | 143.1520 | 124.0180 | 107.5906 | 74.6032 | 44.0219 | 32.1420 | (83) |
| Total gains | 424.5657 | 451.6141 | 471.1136 | 479.8112 | 476.4598 | 460.9249 | 438.9185 | 422.3453 | 417.8375 | 406.0065 | 401.0415 | 411.4449 | (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 | 23.2446 | 23.3091 | 23.3091 | 23.5710 | 23.5050 | 23.8388 | 23.9751 | 23.9751 | 23.8388 | 23.5710 | 23.5710 | 23.5050 | |
| alpha | 2.5496 | 2.5539 | 2.5539 | 2.5714 | 2.5670 | 2.5893 | 2.5983 | 2.5983 | 2.5893 | 2.5714 | 2.5714 | 2.5670 | |
| util living area | 0.8595 | 0.8339 | 0.7948 | 0.7192 | 0.6099 | 0.4740 | 0.3796 | 0.4001 | 0.5660 | 0.7298 | 0.8234 | 0.8671 | (86) |
| MIT | 19.1993 | 19.4196 | 19.7425 | 20.2227 | 20.6146 | 20.8582 | 20.9393 | 20.9296 | 20.7510 | 20.2962 | 19.7082 | 19.1635 | (87) |
| Th 2 | 20.2111 | 20.2131 | 20.2131 | 20.2212 | 20.2192 | 20.2293 | 20.2334 | 20.2334 | 20.2293 | 20.2212 | 20.2212 | 20.2192 | (88) |
| util rest of house | 0.8473 | 0.8197 | 0.7771 | 0.6939 | 0.5729 | 0.4238 | 0.3200 | 0.3396 | 0.5196 | 0.7011 | 0.8062 | 0.8555 | (89) |
| MIT 2 | 18.1048 | 18.3794 | 18.7791 | 19.3712 | 19.8320 | 20.1076 | 20.1905 | 20.1826 | 19.9981 | 19.4687 | 18.7499 | 18.0657 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 18.5330 | 18.7863 | 19.1561 | 19.7044 | 20.1382 | 20.4013 | 20.4834 | 20.4749 | 20.2926 | 19.7924 | 19.1248 | 18.4952 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.5330 | 18.7863 | 19.1561 | 19.7044 | 20.1382 | 20.4013 | 20.4834 | 20.4749 | 20.2926 | 19.7924 | 19.1248 | 18.4952 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8163 | 0.7898 | 0.7501 | 0.6757 | 0.5689 | 0.4353 | 0.3399 | 0.3591 | 0.5236 | 0.6837 | 0.7783 | 0.8248 | (94) |
| Useful gains | 346.5818 | 356.6854 | 353.3681 | 324.2072 | 271.0491 | 200.6447 | 149.1706 | 151.6757 | 218.7827 | 277.5852 | 312.1311 | 339.3494 | (95) |
| Ext temp. | 4.7000 | 5.3000 | 6.7000 | 9.3000 | 12.3000 | 15.0000 | 16.6000 | 16.5000 | 14.1000 | 10.8000 | 7.5000 | 4.6000 | (96) |
| Heat loss rate W | 573.9160 | 557.9816 | 515.3548 | 425.6867 | 321.5923 | 218.5066 | 156.2101 | 159.8883 | 250.5195 | 367.9182 | 475.6188 | 570.1084 | (97) |
| Space heating kWh | 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 892.1987 | |
| 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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (98c) |

Space heating requirement after solar contribution - total per year (kWh/year) 892.1987

Space heating per m2 (98c) / (4) = 18.2566 (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) |
| Fraction of main heating from main system 2 | 0.0000 | (203) |
| Fraction of total heating from main system 1 | 1.0000 | (204) |
| Fraction of total heating from main system 2 | 0.0000 | (205) |
| Efficiency of main space heating system 1 (in %) | 100.0000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (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) |
| Space heating fuel used, main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 324.5200 | (216) |
| (217)m | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 60.0768 | 53.0567 | 56.1685 | 48.8988 | 47.0745 | 42.0617 | 41.2458 | 43.0779 | 43.7671 | 49.2324 | 52.8761 | 59.3557 | (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 | 15.6682 | 14.1519 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | (231) |
| Lighting | 16.7415 | 13.4307 | 12.0928 | 8.8597 | 6.8435 | 5.5912 | 6.2429 | 8.1147 | 10.5402 | 13.8293 | 15.6202 | 17.2068 | (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 | 892.1987 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 324.5200 | |
| Water heating fuel used | 596.8921 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2180) | | |
| mechanical ventilation fans (SFP = 1.2180) | 184.4804 | (230a) |
| Total electricity for the above, kWh/year | 184.4804 | (231) |
| Electricity for lighting (calculated in Appendix L) | 135.1135 | (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 | 1808.6847 | (238) |

---

10a. Fuel costs - using BEDF prices (577)

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| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 892.1987 | 28.4300 | 253.6521 | (240) |
| Space heating - main system 2 | 0.0000 | 28.4300 | 0.0000 | (241) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 28.4300 | 169.6964 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 28.4300 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 184.4804 | 28.4300 | 52.4478 | (249) |
| Energy for lighting | 135.1135 | 28.4300 | 38.4128 | (250) |
| Additional standing charges | | | 0.0000 | (251) |
| Total energy cost | | | 514.2091 | (255) |

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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 | 892.1987 | 0.1546 | 137.9632 | (261) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (262) |

| | | | |
|---|---|---|---|
| Total CO2 associated with community systems | | | 0.0000 (373) |
| Water heating (other fuel) | 596.8921 | 0.1411 | 84.2266 (264) |
| Space and water heating | | | 222.1898 (265) |
| Pumps, fans and electric keep-hot | 184.4804 | 0.1387 | 25.5897 (267) |
| Energy for lighting | 135.1135 | 0.1443 | 19.5011 (268) |
| Total CO2, kg/year | | | 267.2806 (272) |

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 | 892.1987 | 1.5725 | 1402.9798 | (275) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (276) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 1.5218 | 908.3378 | (278) |
| Space and water heating | | | 2311.3176 | (279) |
| Pumps, fans and electric keep-hot | 184.4804 | 1.5128 | 279.0820 | (281) |
| Energy for lighting | 135.1135 | 1.5338 | 207.2416 | (282) |
| Total Primary energy kWh/year | | | 2797.6412 | (286) |

SAP 10 EPC IMPROVEMENTS

001

Current energy efficiency rating: B 81
Current environmental impact rating: A 96

| | |
|---|---|
| N Solar water heating | Not applicable |
| U Solar photovoltaic panels | Not applicable |
| V2 Wind turbine | Not applicable |

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

| Recommended measures | Typical annual savings | Energy efficiency | Environmental impact |
|---|---|---|---|
| (none) | | | |
| Total Savings | £0 | 0.00 kg/m² | |

Potential energy efficiency rating: B 81
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 577 TEST (01 Aug 2025)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

| | Current | Potential | Saving |
|---|---|---|---|
| Electricity | £514 | £514 | £0 |
| Space heating | £306 | £306 | £0 |
| Water heating | £170 | £170 | £0 |
| Lighting | £38 | £38 | £0 |
| Total cost of fuels | £514 | £514 | £0 |
| Total cost of uses | £514 | £514 | £0 |
| Delivered energy | 37 kWh/m² | 37 kWh/m² | 0 kWh/m² |
| Carbon dioxide emissions | 0.3 tonnes | 0.3 tonnes | 0.0 tonnes |
| CO2 emissions per m² | 5 kg/m² | 5 kg/m² | 0 kg/m² |
| Primary energy | 57 kWh/m² | 57 kWh/m² | 0 kWh/m² |

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

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (5) |

2. Ventilation rate

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

| | | |
|---|---|---|
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 2.6400 (17) |
| Infiltration rate | | 0.1320 (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) = | 0.1122 (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 | 0.1431 | 0.1403 | 0.1374 | 0.1234 | 0.1206 | 0.1066 | 0.1066 | 0.1038 | 0.1122 | 0.1206 | 0.1262 | 0.1318 | (22b) |

| | | |
|---|---|---|
| Balanced mechanical ventilation with heat recovery | | |
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 80.1000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2426 | 0.2397 | 0.2369 | 0.2229 | 0.2201 | 0.2061 | 0.2061 | 0.2033 | 0.2117 | 0.2201 | 0.2257 | 0.2313 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| Door | | | 2.1500 | 0.7800 | 1.6770 | | | (26) |
| Window | | | 5.7300 | 0.7282 | 4.1723 | | | (27) |
| GF | | | 3.0200 | 0.0900 | 0.2718 | 75.0000 | 226.5000 | (28a) |
| Exposed Floor | | | 1.6100 | 0.1400 | 0.2254 | 20.0000 | 32.2000 | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1300 | 7.7236 | 9.0000 | 534.7089 | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | 9.0000 | 412.6500 | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1200 | 0.3624 | 9.0000 | 27.1800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.4760 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | 20.0000 | 533.0000 | (32) |
| Party Floor 1 | | | 37.9700 | | | 30.0000 | 1139.1000 | (32d) |
| Timber | | | 50.4000 | | | 9.0000 | 453.6000 | (32c) |
| Internal Floor 1 | | | 6.2700 | | | 18.0000 | 112.8600 | (32d) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 3471.7989 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 71.0415 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.1150 | 0.6670 |
| E3 Sill | 5.8000 | 0.0170 | 0.0986 |
| E4 Jamb | 16.2000 | 0.0940 | 1.5228 |
| E5 Ground floor (normal) | 2.0100 | 0.0670 | 0.1347 |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0320 | 0.6992 |
| E16 Corner (normal) | 10.0800 | 0.0680 | 0.6854 |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0290 | -0.1462 |
| P1 Party wall - Ground floor | 5.1000 | 0.0560 | 0.2856 |
| E18 Party wall between dwellings | 11.4000 | 0.2400 | 2.7360 |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0560 | 0.2822 |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0320 | 0.0826 |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0420 | 0.6707 |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0770 | 0.6514 |
| E14 Flat roof | 2.0100 | 0.2050 | 0.4120 |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.1500 | 0.3015 |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1020 | 0.5008 |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.4800 | 1.4400 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 12.6501 (36) |
| Point Thermal bridges | (36a) = | 0.0000 |
| Total fabric heat loss | (33) + (36) + (36a) = | 32.1261 (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 | 9.9373 | 9.8224 | 9.7074 | 9.1328 | 9.0179 | 8.4433 | 8.4433 | 8.3284 | 8.6732 | 9.0179 | 9.2478 | 9.4776 | (38) |
| Heat transfer coeff | 42.0634 | 41.9484 | 41.8335 | 41.2589 | 41.1440 | 40.5694 | 40.5694 | 40.4545 | 40.7993 | 41.1440 | 41.3738 | 41.6037 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 41.2302 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8607 | 0.8584 | 0.8560 | 0.8443 | 0.8419 | 0.8301 | 0.8301 | 0.8278 | 0.8349 | 0.8419 | 0.8466 | 0.8513 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8437 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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

| | | |
|---|---|---|
| Assumed occupancy | | 1.6569 (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | | 97.5150 (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |

Distribution loss (46)m = 0.15 x (45)m

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |

Water storage loss:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Store volume | | | | | | | | | | | | 200.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.6100 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.8694 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (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 | | | | | | | | | | | | | |
| | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (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 | | | | | | | | | | | | | |
| | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1937.0342 | (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 | | | | | | | | | | | | | |
| | 55.8632 | 49.1556 | 51.6461 | 44.0910 | 41.8334 | 36.7136 | 35.5441 | 37.5210 | 38.5537 | 44.1619 | 48.3826 | 55.0851 | (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 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 19.1267 | 16.9882 | 13.8157 | 10.4594 | 7.8185 | 6.6007 | 7.1323 | 9.2708 | 12.4433 | 15.7996 | 18.4405 | 19.6583 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 215.3723 | 217.6072 | 211.9753 | 199.9858 | 184.8511 | 170.6267 | 161.1239 | 158.8890 | 164.5209 | 176.5104 | 191.6451 | 205.8695 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | (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) | | | | | | | | | | | | | |
| | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 75.0850 | 73.1483 | 69.4168 | 61.2375 | 56.2277 | 50.9911 | 47.7744 | 50.4314 | 53.5468 | 59.3573 | 67.1981 | 74.0392 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 389.3200 | 387.4796 | 374.9438 | 351.4186 | 328.6333 | 307.9544 | 295.7665 | 298.3273 | 310.2469 | 331.4033 | 357.0196 | 379.3029 | (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 | 2.8600 | 10.6334 | 0.3800 | 0.0000 | 0.7700 | 8.8984 | (74) |
| South | 2.0500 | 46.7521 | 0.3800 | 0.0000 | 0.7700 | 28.0433 | (78) |
| West | 0.8200 | 19.6403 | 0.3800 | 0.0000 | 0.7700 | 4.7123 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 41.6540 | 72.1513 | 102.5811 | 134.6775 | 158.5625 | 161.0216 | 153.7257 | 135.2141 | 113.5130 | 80.7182 | 50.0939 | 35.5253 | (83) |
| Total gains | 430.9740 | 459.6309 | 477.5249 | 486.0961 | 487.1958 | 468.9760 | 449.4922 | 433.5414 | 423.7599 | 412.1216 | 407.1135 | 414.8282 | (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 | 22.9270 | 22.9899 | 23.0530 | 23.3741 | 23.4393 | 23.7713 | 23.7713 | 23.8388 | 23.6374 | 23.4393 | 23.3091 | 23.1804 | |
| alpha | 2.5285 | 2.5327 | 2.5369 | 2.5583 | 2.5626 | 2.5848 | 2.5848 | 2.5893 | 2.5758 | 2.5626 | 2.5539 | 2.5454 | |
| util living area | | | | | | | | | | | | | |
| | 0.8632 | 0.8378 | 0.7969 | 0.7285 | 0.6281 | 0.4927 | 0.3743 | 0.4004 | 0.5631 | 0.7327 | 0.8290 | 0.8722 | (86) |
| MIT | 19.0997 | 19.3287 | 19.6970 | 20.1588 | 20.5554 | 20.8333 | 20.9401 | 20.9270 | 20.7503 | 20.2691 | 19.6244 | 19.0523 | (87) |
| Th 2 | 20.2010 | 20.2030 | 20.2050 | 20.2151 | 20.2172 | 20.2273 | 20.2273 | 20.2293 | 20.2232 | 20.2172 | 20.2131 | 20.2091 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8514 | 0.8241 | 0.7793 | 0.7043 | 0.5937 | 0.4448 | 0.3149 | 0.3409 | 0.5165 | 0.7045 | 0.8126 | 0.8611 | (89) |
| MIT 2 | 17.9731 | 18.2589 | 18.7171 | 19.2891 | 19.7614 | 20.0796 | 20.1852 | 20.1760 | 19.9918 | 19.4328 | 18.6400 | 17.9196 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 18.4139 | 18.6774 | 19.1005 | 19.6294 | 20.0720 | 20.3745 | 20.4805 | 20.4698 | 20.2886 | 19.7600 | 19.0251 | 18.3628 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.4139 | 18.6774 | 19.1005 | 19.6294 | 20.0720 | 20.3745 | 20.4805 | 20.4698 | 20.2886 | 19.7600 | 19.0251 | 18.3628 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8199 | 0.7934 | 0.7517 | 0.6846 | 0.5869 | 0.4542 | 0.3348 | 0.3599 | 0.5206 | 0.6865 | 0.7838 | 0.8298 | (94) |
| Useful gains | 353.3502 | 364.6787 | 358.9728 | 332.7727 | 285.9323 | 213.0049 | 150.4744 | 156.0530 | 220.5931 | 282.9069 | 319.0759 | 344.2287 | (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 | | | | | | | | | | | | | |
| | 593.6772 | 577.9418 | 527.1234 | 442.6831 | 344.4594 | 234.2669 | 157.4304 | 164.6434 | 252.4883 | 376.8784 | 493.3892 | 589.2246 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 947.5971 | |
| 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 | | | | | | | | | | | | | |
| | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 947.5971 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 19.3902 | (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) |
| Fraction of main heating from main system 2 | | | | | | | | | | | | 0.0000 | (203) |
| Fraction of total heating from main system 1 | | | | | | | | | | | | 1.0000 | (204) |
| Fraction of total heating from main system 2 | | | | | | | | | | | | 0.0000 | (205) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 100.0000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 178.8033 | 143.3128 | 125.1040 | 79.1355 | 43.5442 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.9148 | 125.5056 | 182.2769 | (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) |
| Space heating fuel used, main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| | | | | | | | | | | | | | |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 324.5200 | (216) |
| (217)m | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 60.0768 | 53.0567 | 56.1685 | 48.8988 | 47.0745 | 42.0617 | 41.2458 | 43.0779 | 43.7671 | 49.2324 | 52.8761 | 59.3557 | (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 | 15.6682 | 14.1519 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | (231) |
| Lighting | 16.7415 | 13.4307 | 12.0928 | 8.8597 | 6.8435 | 5.5912 | 6.2429 | 8.1147 | 10.5402 | 13.8293 | 15.6202 | 17.2068 | (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 | | | | | | | | | | | | 947.5971 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 324.5200 | |
| Water heating fuel used | | | | | | | | | | | | 596.8921 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |
| | | | | | | | | | | | | | |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2180) | | | | | | | | | | | | | |
| mechanical ventilation fans (SFP = 1.2180) | | | | | | | | | | | | 184.4804 | (230a) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 184.4804 | (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 135.1135 | (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 | | | | | | | | | | | | 1864.0831 | (238) |

---

10a. Fuel costs - using Table 12 prices

---

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 947.5971 | 16.4900 | 156.2588 | (240) |
| Space heating - main system 2 | 0.0000 | 16.4900 | 0.0000 | (241) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 16.4900 | 98.4275 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 16.4900 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 184.4804 | 16.4900 | 30.4208 | (249) |
| Energy for lighting | 135.1135 | 16.4900 | 22.2802 | (250) |
| Additional standing charges | | | 0.0000 | (251) |
| Total energy cost | | | 307.3873 | (255) |

---

11a. SAP rating - Individual heating systems

---

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12): | | 0.3600 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] / [(4) + 45.0] = | 1.1789 | (257) |
| SAP value | | 80.8907 | |
| SAP rating (Section 12) | | 81 | (258) |
| SAP band | | B | |

---

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 947.5971 | 0.1545 | 146.4510 | (261) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (262) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 596.8921 | 0.1411 | 84.2266 | (264) |
| Space and water heating | | | 230.6776 | (265) |
| Pumps, fans and electric keep-hot | 184.4804 | 0.1387 | 25.5897 | (267) |
| Energy for lighting | 135.1135 | 0.1443 | 19.5011 | (268) |
| Total CO2, kg/year | | | 275.7684 | (272) |
| CO2 emissions per m2 | | | 5.6400 | (273) |
| EI value | | | 96.0634 | |
| EI rating | | | 96 | (274) |
| EI band | | | A | |

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

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 3.0200 (1b) | x | 2.8500 (2b) | = | 8.6070 | (1b) - (3b) |
| First floor | 45.8500 (1c) | x | 2.5200 (2c) | = | 115.5420 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 48.8700 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 124.1490 | (5) |

## 2. Ventilation rate

| | m3 per hour | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 2.6400 | (17) |
| Infiltration rate | | 0.1320 | (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) = | 0.1122 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 4.6000 | 4.5000 | 4.5000 | 4.1000 | 4.2000 | 3.7000 | 3.5000 | 3.5000 | 3.7000 | 4.1000 | 4.1000 | 4.2000 | (22) |
| Wind factor | 1.1500 | 1.1250 | 1.1250 | 1.0250 | 1.0500 | 0.9250 | 0.8750 | 0.8750 | 0.9250 | 1.0250 | 1.0250 | 1.0500 | (22a) |
| Adj infilt rate | 0.1290 | 0.1262 | 0.1262 | 0.1150 | 0.1178 | 0.1038 | 0.0982 | 0.0982 | 0.1038 | 0.1150 | 0.1150 | 0.1178 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 80.1000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2285 | 0.2257 | 0.2257 | 0.2145 | 0.2173 | 0.2033 | 0.1977 | 0.1977 | 0.2033 | 0.2145 | 0.2145 | 0.2173 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Door | | | 2.1500 | 0.7800 | 1.6770 | | | (26) |
| Window | | | 5.7300 | 0.7282 | 4.1723 | | | (27) |
| GF | | | 3.0200 | 0.0900 | 0.2718 | 75.0000 | 226.5000 | (28a) |
| Exposed Floor | | | 1.6100 | 0.1400 | 0.2254 | 20.0000 | 32.2000 | (28b) |
| Main | 67.2921 | 7.8800 | 59.4121 | 0.1300 | 7.7236 | 9.0000 | 534.7089 | (29a) |
| PIJ | 45.8500 | | 45.8500 | 0.1100 | 5.0435 | 9.0000 | 412.6500 | (30) |
| Flat | 3.0200 | | 3.0200 | 0.1200 | 0.3624 | 9.0000 | 27.1800 | (30) |
| Total net area of external elements Aum(A, m2) | | | 120.7921 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.4760 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall 1 | | | 26.6500 | 0.0000 | 0.0000 | 20.0000 | 533.0000 | (32) |
| Party Floor 1 | | | 37.9700 | | | 30.0000 | 1139.1000 | (32d) |
| Timber | | | 50.4000 | | | 9.0000 | 453.6000 | (32c) |
| Internal Floor 1 | | | 6.2700 | | | 18.0000 | 112.8600 | (32d) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 3471.7989 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 71.0415 (35) |

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 5.8000 | 0.1150 | 0.6670 |
| E3 Sill | 5.8000 | 0.0170 | 0.0986 |
| E4 Jamb | 16.2000 | 0.0940 | 1.5228 |

| | | | | |
|---|---|---|---|---|
| E5 Ground floor (normal) | 2.0100 | 0.0670 | 0.1347 | |
| E7 Party floor between dwellings (in blocks of flats) | 21.8500 | 0.0320 | 0.6992 | |
| E16 Corner (normal) | 10.0800 | 0.0680 | 0.6854 | |
| E17 Corner (inverted - internal area greater than external area) | 5.0400 | -0.0290 | -0.1462 | |
| P1 Party wall - Ground floor | 5.1000 | 0.0560 | 0.2856 | |
| E18 Party wall between dwellings | 11.4000 | 0.2400 | 2.7360 | |
| E25 Staggered party wall between dwellings | 5.0400 | 0.0560 | 0.2822 | |
| E20 Exposed floor (normal) | 1.2700 | 0.3200 | 0.4064 | |
| E21 Exposed floor (inverted) | 3.8100 | 0.3200 | 1.2192 | |
| E6 Intermediate floor within a dwelling | 2.5800 | 0.0320 | 0.0826 | |
| E10 Eaves (insulation at ceiling level) | 15.9700 | 0.0420 | 0.6707 | |
| E12 Gable (insulation at ceiling level) | 8.4600 | 0.0770 | 0.6514 | |
| E14 Flat roof | 2.0100 | 0.2050 | 0.4120 | |
| E24 Eaves (insulation at ceiling level - inverted) | 2.0100 | 0.1500 | 0.3015 | |
| P4 Party wall - Roof (insulation at ceiling level) | 4.9100 | 0.1020 | 0.5008 | |
| P5 Party wall - Roof (insulation at rafter level) | 3.0000 | 0.4800 | 1.4400 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.6501 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.1261 (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 | 9.3627 | 9.2478 | 9.2478 | 8.7881 | 8.9030 | 8.3284 | 8.0986 | 8.0986 | 8.3284 | 8.7881 | 8.7881 | 8.9030 | (38) |
| Heat transfer coeff | 41.4888 | 41.3738 | 41.3738 | 40.9142 | 41.0291 | 40.4545 | 40.2247 | 40.2247 | 40.4545 | 40.9142 | 40.9142 | 41.0291 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 40.8663 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8490 | 0.8466 | 0.8466 | 0.8372 | 0.8396 | 0.8278 | 0.8231 | 0.8231 | 0.8278 | 0.8372 | 0.8372 | 0.8396 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8362 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

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

---

Assumed occupancy 1.6569 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.0000 | 51.2186 | 50.0798 | 47.9010 | 46.2932 | 44.5001 | 43.4809 | 44.6110 | 45.8498 | 47.7751 | 50.0006 | 51.8008 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.4849 | 22.1510 | 21.6808 | 20.8137 | 20.1645 | 19.4446 | 19.0557 | 19.5227 | 20.0311 | 20.8014 | 21.6863 | 22.4089 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.5982 | 30.4492 | 29.3001 | 28.1511 | 27.0021 | 25.8531 | 25.8531 | 27.0021 | 28.1511 | 29.3001 | 30.4492 | 31.5982 | (42c) |

Average daily hot water use (litres/day) 97.5150 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 106.0831 | 103.8187 | 101.0607 | 96.8659 | 93.4597 | 89.7977 | 88.3896 | 91.1358 | 94.0320 | 97.8766 | 102.1361 | 105.8079 | (44) |
| Energy conte | 168.0098 | 147.8365 | 155.3265 | 132.6045 | 125.8147 | 110.4167 | 106.8996 | 112.8451 | 115.9509 | 132.8176 | 145.5116 | 165.6696 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1619.7032 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.2015 | 22.1755 | 23.2990 | 19.8907 | 18.8722 | 16.5625 | 16.0349 | 16.9268 | 17.3926 | 19.9226 | 21.8267 | 24.8504 | (46) |

Water storage loss:

Store volume 200.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6100 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.8694 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.9514 | 24.3432 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | 26.9514 | 26.0820 | 26.9514 | 26.0820 | 26.9514 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (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 | | | | | | | | | | | | | |
| 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1937.0342 | (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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55.8632 | 49.1556 | 51.6461 | 44.0910 | 41.8334 | 36.7136 | 35.5441 | 37.5210 | 38.5537 | 44.1619 | 48.3826 | 55.0851 | (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 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | 99.4132 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 19.1267 | 16.9882 | 13.8157 | 10.4594 | 7.8185 | 6.6007 | 7.1323 | 9.2708 | 12.4433 | 15.7996 | 18.4405 | 19.6583 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 215.3723 | 217.6072 | 211.9753 | 199.9858 | 184.8511 | 170.6267 | 161.1239 | 158.8890 | 164.5209 | 176.5104 | 191.6451 | 205.8695 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | 46.5982 | (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) | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | -66.2755 | (71) |
| Water heating gains (Table 5) | 75.0850 | 73.1483 | 69.4168 | 61.2375 | 56.2277 | 50.9911 | 47.7744 | 50.4314 | 53.5468 | 59.3573 | 67.1981 | 74.0392 | (72) |
| Total internal gains | 389.3200 | 387.4796 | 374.9438 | 351.4186 | 328.6333 | 307.9544 | 295.7665 | 298.3273 | 310.2469 | 331.4033 | 357.0196 | 379.3029 | (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 | | | | 2.8600 | | 8.9975 | | 0.3800 | | 0.0000 | | 0.7700 | 7.5294 (74) |
| South | | | | 2.0500 | | 39.5594 | | 0.3800 | | 0.0000 | | 0.7700 | 23.7289 (78) |
| West | | | | 0.8200 | | 16.6187 | | 0.3800 | | 0.0000 | | 0.7700 | 3.9874 (80) |
| Solar gains | 35.2457 | 64.1345 | 96.1698 | 128.3926 | 147.8265 | 152.9705 | 143.1520 | 124.0180 | 107.5906 | 74.6032 | 44.0219 | 32.1420 (83) | |
| Total gains | 424.5657 | 451.6141 | 471.1136 | 479.8112 | 476.4598 | 460.9249 | 438.9185 | 422.3453 | 417.8375 | 406.0065 | 401.0415 | 411.4449 (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 | 23.2446 | 23.3091 | 23.3091 | 23.5710 | 23.5050 | 23.8388 | 23.9751 | 23.9751 | 23.8388 | 23.5710 | 23.5710 | 23.5050 | |
| alpha | 2.5496 | 2.5539 | 2.5539 | 2.5714 | 2.5670 | 2.5893 | 2.5983 | 2.5983 | 2.5893 | 2.5714 | 2.5714 | 2.5670 | |
| util living area | 0.8595 | 0.8339 | 0.7948 | 0.7192 | 0.6099 | 0.4740 | 0.3796 | 0.4001 | 0.5660 | 0.7298 | 0.8234 | 0.8671 | (86) |
| MIT | 19.1993 | 19.4196 | 19.7425 | 20.2227 | 20.6146 | 20.8582 | 20.9393 | 20.9296 | 20.7510 | 20.2962 | 19.7082 | 19.1635 | (87) |
| Th 2 | 20.2111 | 20.2131 | 20.2131 | 20.2212 | 20.2192 | 20.2293 | 20.2334 | 20.2334 | 20.2293 | 20.2212 | 20.2212 | 20.2192 | (88) |
| util rest of house | 0.8473 | 0.8197 | 0.7771 | 0.6939 | 0.5729 | 0.4238 | 0.3200 | 0.3396 | 0.5196 | 0.7011 | 0.8062 | 0.8555 | (89) |
| MIT 2 | 18.1048 | 18.3794 | 18.7791 | 19.3712 | 19.8320 | 20.1076 | 20.1905 | 20.1826 | 19.9981 | 19.4687 | 18.7499 | 18.0657 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3912 | (91) |
| MIT | 18.5330 | 18.7863 | 19.1561 | 19.7044 | 20.1382 | 20.4013 | 20.4834 | 20.4749 | 20.2926 | 19.7924 | 19.1248 | 18.4952 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.5330 | 18.7863 | 19.1561 | 19.7044 | 20.1382 | 20.4013 | 20.4834 | 20.4749 | 20.2926 | 19.7924 | 19.1248 | 18.4952 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8163 | 0.7898 | 0.7501 | 0.6757 | 0.5689 | 0.4353 | 0.3399 | 0.3591 | 0.5236 | 0.6837 | 0.7783 | 0.8248 | (94) |
| Useful gains | 346.5818 | 356.6854 | 353.3681 | 324.2072 | 271.0491 | 200.6447 | 149.1706 | 151.6757 | 218.7827 | 277.5852 | 312.1311 | 339.3494 | (95) |
| Ext temp. | 4.7000 | 5.3000 | 6.7000 | 9.3000 | 12.3000 | 15.0000 | 16.6000 | 16.5000 | 14.1000 | 10.8000 | 7.5000 | 4.6000 | (96) |
| Heat loss rate W | 573.9160 | 557.9816 | 515.3548 | 425.6867 | 321.5923 | 218.5066 | 156.2101 | 159.8883 | 250.5195 | 367.9182 | 475.6188 | 570.1084 | (97) |
| Space heating kWh | 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 892.1987 | |
| 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 | 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 892.1987 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 18.2566 | (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) |
| Fraction of main heating from main system 2 | 0.0000 (203) |
| Fraction of total heating from main system 1 | 1.0000 (204) |
| Fraction of total heating from main system 2 | 0.0000 (205) |
| Efficiency of main space heating system 1 (in %) | 100.0000 (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (98) |
| Space heating efficiency (main heating system 1) | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 100.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.0000 | 100.0000 | 100.0000 | (210) |
| Space heating fuel (main heating system) | 169.1367 | 135.2710 | 120.5180 | 73.0652 | 37.6041 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 67.2077 | 117.7111 | 171.6847 | (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) |
| Space heating fuel used, main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 194.9612 | 172.1797 | 182.2779 | 158.6865 | 152.7661 | 136.4987 | 133.8510 | 139.7965 | 142.0329 | 159.7690 | 171.5936 | 192.6210 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 324.5200 | (216) |
| (217)m | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | 324.5200 | (217) |
| Fuel for water heating, kWh/month | 60.0768 | 53.0567 | 56.1685 | 48.8988 | 47.0745 | 42.0617 | 41.2458 | 43.0779 | 43.7671 | 49.2324 | 52.8761 | 59.3557 | (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 | 15.6682 | 14.1519 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | 15.6682 | 15.1628 | 15.6682 | 15.1628 | 15.6682 | (231) |
| Lighting | 16.7415 | 13.4307 | 12.0928 | 8.8597 | 6.8435 | 5.5912 | 6.2429 | 8.1147 | 10.5402 | 13.8293 | 15.6202 | 17.2068 | (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 | | | | | | | | | | | | 892.1987 | (211) |

| | | |
|---|---|---|
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 324.5200 | |
| Water heating fuel used | 596.8921 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.2180) | | |
| mechanical ventilation fans (SFP = 1.2180) | 184.4804 | (230a) |
| Total electricity for the above, kWh/year | 184.4804 | (231) |
| Electricity for lighting (calculated in Appendix L) | 135.1135 | (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 | 1808.6847 | (238) |

10a. Fuel costs - using BEDF prices (577)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 892.1987 | 28.4300 | 253.6521 | (240) |
| Space heating - main system 2 | 0.0000 | 28.4300 | 0.0000 | (241) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 28.4300 | 169.6964 | (247) |
| Energy for instantaneous electric shower(s) | 0.0000 | 28.4300 | 0.0000 | (247a) |
| Pumps, fans and electric keep-hot | 184.4804 | 28.4300 | 52.4478 | (249) |
| Energy for lighting | 135.1135 | 28.4300 | 38.4128 | (250) |
| Additional standing charges | | | 0.0000 | (251) |
| Total energy cost | | | 514.2091 | (255) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 892.1987 | 0.1546 | 137.9632 | (261) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (262) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 596.8921 | 0.1411 | 84.2266 | (264) |
| Space and water heating | | | 222.1898 | (265) |
| Pumps, fans and electric keep-hot | 184.4804 | 0.1387 | 25.5897 | (267) |
| Energy for lighting | 135.1135 | 0.1443 | 19.5011 | (268) |
| Total CO2, kg/year | | | 267.2806 | (272) |

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 | 892.1987 | 1.5725 | 1402.9798 | (275) |
| Space heating - main system 2 | 0.0000 | 0.0000 | 0.0000 | (276) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 596.8921 | 1.5218 | 908.3378 | (278) |
| Space and water heating | | | 2311.3176 | (279) |
| Pumps, fans and electric keep-hot | 184.4804 | 1.5128 | 279.0820 | (281) |
| Energy for lighting | 135.1135 | 1.5338 | 207.2416 | (282) |
| Total Primary energy kWh/year | | | 2797.6412 | (286) |