# FULL SAP CALCULATION PRINTOUT
# Calculation Type: New Build (As Built)

| | | | |
|---|---|---|---|
| **Property Reference** | SECPMW027e_088_As_Built | **Issued on Date** | 07/05/2021 |
| **Assessment Reference** | 001 | **Prop Type Ref** | MFF |
| **Property** | | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 86 B | **DER** | 13.46 | **TER** | 15.53 |
| **Environmental** | 90 B | **% DER<TER** | 13.33 | | |
| **$CO_2$ Emissions (t/year)** | 0.81 | **DFEE** | 27.84 | **TFEE** | 34.35 |
| **General Requirements Compliance** | Pass | **% DFEE<TFEE** | 18.94 | | |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Robert Price, Robert Price, Tel: 01635 261582, keith@southernenergyconsultants.co.uk | **Assessor ID** | P865-0001 |
| **Client** | Bellway Homes Thames Valley | | |



Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r16

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

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

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DWELLING AS BUILT

Mid-floor flat, total floor area 73 m²

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

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1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.53 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.46 kgCO□/m²OK

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1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)34.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)27.8 kWh/m²/yrOK

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2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.16 (max. 0.30) | 0.16 (max. 0.70) | OK |
| Party wall | 0.00 (max. 0.20) | - | OK |
| Floor | (no floor) | | |
| Roof | (no roof) | | |
| Openings | 1.25 (max. 2.00) | 1.30 (max. 3.30) | OK |

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2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 3.38 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

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8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1600 0.1600
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing West: 10.22 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Party wall U-value 0.00 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.4 m³/m²h

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

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

### 1. Overall dwelling dimensions

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.2300 (1b) | x | 2.4000 (2b) | = | 175.7520 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 73.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 175.7520 | (5) |

### 2. Ventilation rate

| | main heating | | secondary heating | | other | | total | | m3 per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 * 40 = | | 0.0000 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 * 20 = | | 0.0000 | (6b) |
| Number of intermittent 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)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Measured/design AP50 | | 3.3800 | |
| Infiltration rate | | 0.1690 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1310 | (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 | 0.1670 | 0.1637 | 0.1604 | 0.1441 | 0.1408 | 0.1244 | 0.1244 | 0.1212 | 0.1310 | 0.1408 | 0.1473 | 0.1539 | (22b) |

Mechanical extract ventilation - decentralised

| | | |
|---|---|---|
| If mechanical ventilation: | 0.5000 | (23a) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Opening Type 1 | | | 2.1200 | 1.0000 | 2.1200 | | | (26) |
| Opening Type 2 (Uw = 1.30) | | | 10.2200 | 1.2357 | 12.6293 | | | (27) |
| WT-E-03 | 32.1100 | 10.2200 | 21.8900 | 0.1600 | 3.5024 | | | (29a) |
| WT-I-02 | 21.8400 | 2.1200 | 19.7200 | 0.1584 | 3.1240 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 53.9500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 21.3757 | | | (33) |
| Party Wall 1 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Wall 2 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Floor 1 | | | 72.3300 | | | | | (32d) |
| Party Ceilings 1 | | | 73.2300 | | | | | (32b) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 7.0980 | (36) |
| Total fabric heat loss (33) + (36) = | 28.4737 | (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 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | (38) |
| Heat transfer coeff | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 57.4728 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7848 | (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.3219 | (42) |
| Average daily hot water use (litres/day) | 89.3456 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 98.2802 | 94.7063 | 91.1325 | 87.5587 | 83.9849 | 80.4110 | 80.4110 | 83.9849 | 87.5587 | 91.1325 | 94.7063 | 98.2802 | (44) |
| Energy conte | 145.7467 | 127.4710 | 131.5386 | 114.6785 | 110.0368 | 94.9534 | 87.9883 | 100.9678 | 102.1737 | 119.0736 | 129.9781 | 141.1478 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1405.7543 | (45) |

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21.8620 | 19.1206 | 19.7308 | 17.2018 | 16.5055 | 14.2430 | 13.1982 | 15.1452 | 15.3261 | 17.8610 | 19.4967 | 21.1722 | (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) |
| Combi loss | 14.1003 | 12.7150 | 14.0443 | 13.5538 | 13.9784 | 13.4960 | 13.9264 | 13.9601 | 13.5275 | 14.0170 | 13.6082 | 14.0895 | (61) |
| Total heat required for water heating calculated for each month | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (62) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63) |
| | | | | | | | | Solar input (sum of months) = Sum(63)m = | | | | 0.0000 | (63) |
| Output from w/h | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | | 1570.7708 | (64) |
| Heat gains from water heating, kWh/month | 51.9858 | 45.5628 | 47.2477 | 41.5191 | 40.0818 | 34.9460 | 32.7377 | 37.0618 | 37.3546 | 43.0962 | 46.6198 | 50.4540 | (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 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 19.5929 | 17.4022 | 14.1524 | 10.7143 | 8.0091 | 6.7616 | 7.3061 | 9.4968 | 12.7466 | 16.1847 | 18.8899 | 20.1374 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 204.7153 | 206.8396 | 201.4864 | 190.0901 | 175.7044 | 162.1838 | 153.1512 | 151.0269 | 156.3801 | 167.7764 | 182.1621 | 195.6827 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | (71) |
| Water heating gains (Table 5) | 69.8734 | 67.8019 | 63.5049 | 57.6654 | 53.8734 | 48.5361 | 44.0023 | 49.8143 | 51.8814 | 57.9250 | 64.7497 | 67.8146 | (72) |
| Total internal gains | 355.0104 | 352.8725 | 339.9726 | 319.2986 | 298.4157 | 278.3103 | 265.2884 | 271.1668 | 281.8369 | 302.7149 | 326.6306 | 344.4635 | (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 | |
|---|---|---|---|---|---|---|---|
| West | 10.2200 | 19.6403 | 0.4500 | 0.0000 | 0.7700 | 69.5507 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 69.5507 | 136.0559 | 224.0647 | 326.7850 | 400.4873 | 409.9700 | 390.3082 | 335.2689 | 260.5965 | 161.4418 | 86.7215 | 57.1951 | (83) |
| Total gains | 424.5611 | 488.9284 | 564.0373 | 646.0836 | 698.9030 | 688.2803 | 655.5966 | 606.4357 | 542.4334 | 464.1567 | 413.3521 | 401.6586 | (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 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | |
| alpha | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | |
| util living area | 0.9980 | 0.9942 | 0.9771 | 0.9031 | 0.7326 | 0.5311 | 0.3854 | 0.4351 | 0.7063 | 0.9548 | 0.9949 | 0.9986 | (86) |
| MIT | 20.2635 | 20.3966 | 20.6122 | 20.8462 | 20.9691 | 20.9969 | 20.9997 | 20.9993 | 20.9816 | 20.7877 | 20.4674 | 20.2245 | (87) |
| Th 2 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | (88) |
| util rest of house | 0.9974 | 0.9924 | 0.9701 | 0.8782 | 0.6846 | 0.4717 | 0.3213 | 0.3662 | 0.6409 | 0.9372 | 0.9929 | 0.9982 | (89) |
| MIT 2 | 19.5875 | 19.7198 | 19.9313 | 20.1485 | 20.2475 | 20.2651 | 20.2664 | 20.2663 | 20.2572 | 20.1009 | 19.7908 | 19.5487 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3516 | (91) |
| MIT | 19.8252 | 19.9577 | 20.1707 | 20.3938 | 20.5012 | 20.5224 | 20.5243 | 20.5241 | 20.5119 | 20.3424 | 20.0287 | 19.7864 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 19.6752 | 19.8077 | 20.0207 | 20.2438 | 20.3512 | 20.3724 | 20.3743 | 20.3741 | 20.3619 | 20.1924 | 19.8787 | 19.6364 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9967 | 0.9909 | 0.9673 | 0.8773 | 0.6904 | 0.4804 | 0.3308 | 0.3763 | 0.6498 | 0.9351 | 0.9916 | 0.9977 | (94) |
| Useful gains | 423.1529 | 484.4976 | 545.6168 | 566.8226 | 482.5157 | 330.6365 | 216.8473 | 228.2317 | 352.4551 | 434.0303 | 409.8890 | 400.7283 | (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 | 883.6572 | 856.7900 | 777.0735 | 651.9625 | 497.2106 | 331.7583 | 216.9177 | 228.4007 | 359.8905 | 551.3019 | 734.4274 | 887.1708 | (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) |
| Space heating kWh | 342.6152 | 250.1805 | 172.2038 | 61.3007 | 10.9330 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 87.2500 | 233.6677 | 361.9132 | (98) |
| Space heating | | | | | | | | | | | | 1520.0641 | (98) |
| Space heating per m2 | | | | | | | | | | | (98) / (4) = | 20.7574 | (99) |

### 8c. Space cooling requirement

Not applicable

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

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| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 90.5000 | (206) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |
| Space heating requirement | 1679.6288 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 342.6152 | 250.1805 | 172.2038 | 61.3007 | 10.9330 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 87.2500 | 233.6677 | 361.9132 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 378.5803 | 276.4425 | 190.2804 | 67.7356 | 12.0807 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 96.4088 | 258.1963 | 399.9041 | (211) |
| Water heating requirement | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 87.3000 | (216) |
| (217)m | 89.4568 | 89.3242 | 89.0054 | 88.3099 | 87.5508 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 88.5397 | 89.2548 | 89.5151 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 178.6862 | 156.9407 | 163.5663 | 145.2071 | 141.6494 | 124.2262 | 116.7407 | 131.6471 | 132.5329 | 150.3175 | 160.8725 | 173.4204 | (219) |
| Water heating fuel used | | | | | | | | | | | | 1775.8068 | (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | 1679.6288 | (211) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)

| | | |
|---|---|---|
| mechanical ventilation fans (SFP = 0.1840) | 39.4528 | (230a) |
| central heating pump | 30.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 114.4528 | (231) |
| Electricity for lighting (calculated in Appendix L) | 346.0160 | (232) |
| Total delivered energy for all uses | 3915.9044 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1679.6288 | 0.2160 | 362.7998 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 1775.8068 | 0.2160 | 383.5743 | (264) |
| Space and water heating | | | 746.3741 | (265) |
| Pumps and fans | 114.4528 | 0.5190 | 59.4010 | (267) |
| Energy for lighting | 346.0160 | 0.5190 | 179.5823 | (268) |
| Total CO2, kg/year | | | 985.3574 | (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 13.4600 | (273) |

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

| | | | |
|---|---|---|---|
| DER | | 13.4600 | ZC1 |
| Total Floor Area | TFA | 73.2300 | |
| Assumed number of occupants | N | 2.3219 | |
| CO2 emission factor in Table 12 for electricity displaced from grid | EF | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | 16.5656 | ZC2 |
| CO2 emissions from cooking, equation (L16) | | 2.3860 | ZC3 |
| Total CO2 emissions | | 32.4116 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP | | 0.0000 | ZC5 |
| Additional allowable electricity generation, kWh/m²/year | | 0.0000 | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | | 0.0000 | ZC7 |
| Net CO2 emissions | | 32.4116 | ZC8 |

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## CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

### 1. Overall dwelling dimensions

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.2300 (1b) | x | 2.4000 (2b) | = | 175.7520 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 73.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 175.7520 | (5) |

### 2. Ventilation rate

| | main heating | | secondary heating | | other | | total | | m3 per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 * 40 = | | 0.0000 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 * 20 = | | 0.0000 | (6b) |
| Number of intermittent fans | | | | | | | 3 * 10 = | | 30.0000 | (7a) |
| Number of passive vents | | | | | | | 0 * 10 = | | 0.0000 | (7b) |
| Number of flueless gas fires | | | | | | | 0 * 40 = | | 0.0000 | (7c) |

| | | | |
|---|---|---|---|
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1707 | (8) |
| Pressure test | | Yes | |
| Measured/design AP50 | | 5.0000 | |
| Infiltration rate | | 0.4207 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3260 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4157 | 0.4075 | 0.3994 | 0.3586 | 0.3505 | 0.3097 | 0.3097 | 0.3016 | 0.3260 | 0.3505 | 0.3668 | 0.3831 | (22b) |
| Effective ac | 0.5864 | 0.5830 | 0.5798 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5532 | 0.5614 | 0.5673 | 0.5734 | (25) |

### 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1200 | 1.0000 | 2.1200 | | | (26) |
| TER Opening Type (Uw = 1.40) | | | 10.2200 | 1.3258 | 13.5492 | | | (27) |
| WT-E-03 | 32.1100 | 10.2200 | 21.8900 | 0.1800 | 3.9402 | | | (29a) |
| WT-I-02 | 21.8400 | 2.1200 | 19.7200 | 0.1800 | 3.5496 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 53.9500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 23.1590 | | | (33) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 5.5327 | (36) |
| Total fabric heat loss | | | | | (33) + (36) = | | 28.6917 | (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 | 34.0103 | 33.8157 | 33.6250 | 32.7291 | 32.5615 | 31.7812 | 31.7812 | 31.6367 | 32.0817 | 32.5615 | 32.9005 | 33.2550 | (38) |
| Heat transfer coeff | 62.7020 | 62.5074 | 62.3167 | 61.4208 | 61.2532 | 60.4729 | 60.4729 | 60.3284 | 60.7735 | 61.2532 | 61.5923 | 61.9468 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 61.4200 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8562 | 0.8536 | 0.8510 | 0.8387 | 0.8364 | 0.8258 | 0.8258 | 0.8238 | 0.8299 | 0.8364 | 0.8411 | 0.8459 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8387 | (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.3219 | (42) |
| Average daily hot water use (litres/day) | 89.3456 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 98.2802 | 94.7063 | 91.1325 | 87.5587 | 83.9849 | 80.4110 | 80.4110 | 83.9849 | 87.5587 | 91.1325 | 94.7063 | 98.2802 | (44) |
| Energy conte | 145.7467 | 127.4710 | 131.5386 | 114.6785 | 110.0368 | 94.9534 | 87.9883 | 100.9678 | 102.1737 | 119.0736 | 129.9781 | 141.1478 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1405.7543 | (45) |
| Distribution loss (46)m = 0.15 x (45)m | 21.8620 | 19.1206 | 19.7308 | 17.2018 | 16.5055 | 14.2430 | 13.1982 | 15.1452 | 15.3261 | 17.8610 | 19.4967 | 21.1722 | (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) |
| Combi loss | 50.0825 | 43.5909 | 46.4401 | 43.1796 | 42.7978 | 39.6548 | 40.9766 | 42.7978 | 43.1796 | 46.4401 | 46.7045 | 50.0825 | (61) |

## CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Total heat required for water heating calculated for each month
                195.8291   171.0618   177.9787   157.8582   152.8346   134.6081   128.9649   143.7656   145.3533   165.5137   176.6826   191.2303 (62)
Solar input       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                                Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
                195.8291   171.0618   177.9787   157.8582   152.8346   134.6081   128.9649   143.7656   145.3533   165.5137   176.6826   191.2303 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =   1941.6811 (64)
Heat gains from water heating, kWh/month
                 60.9814    53.2818    55.3466    48.9255    47.2867    41.4857    39.5002    44.2712    44.7677    51.2020    54.8939    59.4523 (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           116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 19.5929    17.4022    14.1524    10.7143     8.0091     6.7616     7.3061     9.4968    12.7466    16.1847    18.8899    20.1374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                204.7153   206.8396   201.4864   190.0901   175.7044   162.1838   153.1512   151.0269   156.3801   167.7764   182.1621   195.6827 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096 (69)
Pumps, fans       3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
                -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768 (71)
Water heating gains (Table 5)
                 81.9642    79.2884    74.3906    67.9521    63.5574    57.6190    53.0917    59.5044    62.1773    68.8199    76.2415    79.9090 (72)
Total internal gains
                367.1012   364.3590   350.8583   329.5854   308.0996   287.3932   274.3779   280.8569   292.1328   313.6098   338.1223   356.5579 (73)


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6. Solar gains
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[Jan]                                      Area        Solar flux              g              FF          Access            Gains
                                            m2          Table 6a     Specific data     Specific data      factor              W
                                                          W/m2       or Table 6b       or Table 6c     Table 6d
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West                                     10.2200          19.6403          0.6300          0.7000          0.7700         61.3437 (80)
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Solar gains     61.3437   120.0013   197.6251   288.2244   353.2298   361.5935   344.2518   295.7072   229.8461   142.3917    76.4884    50.4461 (83)
Total gains    428.4449   484.3603   548.4833   617.8097   661.3294   648.9868   618.6297   576.5641   521.9789   456.0014   414.6107   407.0040 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                    21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             81.1045    81.3570    81.6060    82.7963    83.0229    84.0941    84.0941    84.2956    83.6782    83.0229    82.5658    82.0933
alpha            6.4070     6.4238     6.4404     6.5198     6.5349     6.6063     6.6063     6.6197     6.5785     6.5349     6.5044     6.4729
util living area
                 0.9981     0.9952     0.9838     0.9326     0.7947     0.5883     0.4292     0.4793     0.7572     0.9652     0.9954     0.9986 (86)

MIT             20.1606    20.2892    20.5063    20.7730    20.9400    20.9929    20.9992    20.9984    20.9672    20.7322    20.3974    20.1389 (87)
Th 2            20.2049    20.2071    20.2094    20.2199    20.2219    20.2310    20.2310    20.2327    20.2275    20.2219    20.2179    20.2137 (88)
util rest of house
                 0.9975     0.9937     0.9786     0.9124     0.7467     0.5212     0.3547     0.4005     0.6894     0.9505     0.9936     0.9982 (89)
MIT 2           19.0738    19.2630    19.5785    19.9578    20.1657    20.2264    20.2307    20.2321    20.2025    19.9112    19.4297    19.0489 (90)
Living area fraction                                                                                   fLA = Living area / (4) =      0.3516 (91)
MIT             19.4560    19.6239    19.9047    20.2445    20.4380    20.4959    20.5010    20.5016    20.4714    20.1999    19.7700    19.4322 (92)
Temperature adjustment                                                                                                            0.0000
adjusted MIT    19.4560    19.6239    19.9047    20.2445    20.4380    20.4959    20.5010    20.5016    20.4714    20.1999    19.7700    19.4322 (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      0.9967     0.9923     0.9761     0.9131     0.7607     0.5446     0.3809     0.4283     0.7118     0.9500     0.9923     0.9975 (94)
Useful gains   427.0122   480.6145   535.3697   564.1196   503.0913   353.4394   235.6518   246.9172   371.5677   433.2118   411.4058   406.0006 (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
               950.3099   920.3510   835.3384   696.7856   535.2299   356.5444   235.9021   247.4405   387.2096   588.0247   780.3718   943.5857 (97)
Month fracti     1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               389.3335   295.5029   223.1767    95.5195    23.9111     0.0000     0.0000     0.0000     0.0000   115.1808   265.6555   399.9633 (98)
Space heating                                                                                                                    1808.2434 (98)
Space heating per m2                                                                                                  (98) / (4) =     24.6927 (99)


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8c. Space cooling requirement
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Not applicable


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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)
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## CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | | |
|---|---|---|
| Efficiency of main space heating system 1 (in %) | 93.4000 | (206) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |
| Space heating requirement | 1936.0207 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 389.3335 | 295.5029 | 223.1767 | 95.5195 | 23.9111 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 115.1808 | 265.6555 | 399.9633 | (98) |
| Space heating efficiency (main heating system 1) | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 93.4000 | 93.4000 | 93.4000 | (210) |
| Space heating fuel (main heating system) | 416.8453 | 316.3843 | 238.9472 | 102.2693 | 25.6008 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 123.3199 | 284.4278 | 428.2262 | (211) |
| Water heating requirement | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 195.8291 | 171.0618 | 177.9787 | 157.8582 | 152.8346 | 134.6081 | 128.9649 | 143.7656 | 145.3533 | 165.5137 | 176.6826 | 191.2303 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 80.3000 | (216) |
| (217)m | 86.7485 | 86.4149 | 85.6220 | 83.8309 | 81.5324 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.1583 | 86.0756 | 86.8659 | (217) |
| Fuel for water heating, kWh/month | 225.7435 | 197.9540 | 207.8657 | 188.3056 | 187.4527 | 167.6316 | 160.6038 | 179.0356 | 181.0129 | 196.6695 | 205.2645 | 220.1444 | (219) |
| Water heating fuel used | | | | | | | | | | | | 2317.6836 | (219) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system | 1936.0207 | (211) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Electricity for pumps and fans: | | |
| central heating pump | 30.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 75.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 346.0160 | (232) |
| Total delivered energy for all uses | 4674.7204 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1936.0207 | 0.2160 | 418.1805 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 2317.6836 | 0.2160 | 500.6197 | (264) |
| Space and water heating | | | 918.8001 | (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 | (267) |
| Energy for lighting | 346.0160 | 0.5190 | 179.5823 | (268) |
| Total CO2, kg/m2/year | | | 1137.3075 | (272) |
| Emissions per m2 for space and water heating | | | 12.5468 | (272a) |
| Fuel factor (mains gas) | | | 1.0000 | |
| Emissions per m2 for lighting | | | 2.4523 | (272b) |
| Emissions per m2 for pumps and fans | | | 0.5315 | (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (12.5468 * 1.00) + 2.4523 + 0.5315, rounded to 2 d.p. | | | 15.5300 | (273) |

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## CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

### 1. Overall dwelling dimensions

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.2300 (1b) | x | 2.4000 (2b) | = | 175.7520 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 73.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 175.7520 | (5) |

### 2. Ventilation rate

| | main heating | | secondary heating | | other | | total | | m3 per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 * 40 = | | 0.0000 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 * 20 = | | 0.0000 | (6b) |
| Number of intermittent fans | | | | | | | 3 * 10 = | | 30.0000 | (7a) |
| Number of passive vents | | | | | | | 0 * 10 = | | 0.0000 | (7b) |
| Number of flueless gas fires | | | | | | | 0 * 40 = | | 0.0000 | (7c) |

| | | | |
|---|---|---|---|
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1707 | (8) |
| Pressure test | | Yes | |
| Measured/design AP50 | | 3.3800 | |
| Infiltration rate | | 0.3397 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.2633 | (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 | 0.3357 | 0.3291 | 0.3225 | 0.2896 | 0.2830 | 0.2501 | 0.2501 | 0.2435 | 0.2633 | 0.2830 | 0.2962 | 0.3093 | (22b) |
| Effective ac | 0.5563 | 0.5541 | 0.5520 | 0.5419 | 0.5400 | 0.5313 | 0.5313 | 0.5297 | 0.5347 | 0.5400 | 0.5439 | 0.5478 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Opening Type 1 | | | 2.1200 | 1.0000 | 2.1200 | | | (26) |
| Opening Type 2 (Uw = 1.30) | | | 10.2200 | 1.2357 | 12.6293 | | | (27) |
| WT-E-03 | 32.1100 | 10.2200 | 21.8900 | 0.1600 | 3.5024 | | | (29a) |
| WT-I-02 | 21.8400 | 2.1200 | 19.7200 | 0.1584 | 3.1240 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 53.9500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 21.3757 | | | (33) |
| Party Wall 1 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Wall 2 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Floor 1 | | | 72.3300 | | | | | (32d) |
| Party Ceilings 1 | | | 73.2300 | | | | | (32b) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 7.0980 | (36) |
| Total fabric heat loss (33) + (36) = | 28.4737 | (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 | 32.2664 | 32.1395 | 32.0151 | 31.4310 | 31.3217 | 30.8130 | 30.8130 | 30.7188 | 31.0089 | 31.3217 | 31.5428 | 31.7739 | (38) |
| Heat transfer coeff | 60.7401 | 60.6132 | 60.4888 | 59.9047 | 59.7954 | 59.2867 | 59.2867 | 59.1925 | 59.4827 | 59.7954 | 60.0165 | 60.2477 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 59.9042 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8294 | 0.8277 | 0.8260 | 0.8180 | 0.8165 | 0.8096 | 0.8096 | 0.8083 | 0.8123 | 0.8165 | 0.8196 | 0.8227 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8180 | (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.3219 | (42) |
| Average daily hot water use (litres/day) | 89.3456 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 98.2802 | 94.7063 | 91.1325 | 87.5587 | 83.9849 | 80.4110 | 80.4110 | 83.9849 | 87.5587 | 91.1325 | 94.7063 | 98.2802 | (44) |
| Energy conte | 145.7467 | 127.4710 | 131.5386 | 114.6785 | 110.0368 | 94.9534 | 87.9883 | 100.9678 | 102.1737 | 119.0736 | 129.9781 | 141.1478 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1405.7543 | (45) |
| Distribution loss (46)m = 0.15 x (45)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |

Water storage loss:
Total storage loss

## CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 30.9712 | 27.0876 | 27.9520 | 24.3692 | 23.3828 | 20.1776 | 18.6975 | 21.4557 | 21.7119 | 25.3031 | 27.6204 | 29.9939 | (65) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | 116.0960 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 19.5929 | 17.4022 | 14.1524 | 10.7143 | 8.0091 | 6.7616 | 7.3061 | 9.4968 | 12.7466 | 16.1847 | 18.8899 | 20.1374 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 204.7153 | 206.8396 | 201.4864 | 190.0901 | 175.7044 | 162.1838 | 153.1512 | 151.0269 | 156.3801 | 167.7764 | 182.1621 | 195.6827 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | 34.6096 | (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) | | | | | | | | | | | | | |
| | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 41.6279 | 40.3089 | 37.5698 | 33.8461 | 31.4285 | 28.0244 | 25.1311 | 28.8383 | 30.1554 | 34.0096 | 38.3616 | 40.3144 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 323.7649 | 322.3795 | 311.0375 | 292.4793 | 272.9708 | 254.7986 | 243.4172 | 247.1908 | 257.1109 | 275.7995 | 297.2425 | 313.9633 | (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 | |
|---|---|---|---|---|---|---|---|
| West | 10.2200 | 19.6403 | 0.4500 | 0.0000 | 0.7700 | 69.5507 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 69.5507 | 136.0559 | 224.0647 | 326.7850 | 400.4873 | 409.9700 | 390.3082 | 335.2689 | 260.5965 | 161.4418 | 86.7215 | 57.1951 | (83) |
| Total gains | 393.3156 | 458.4354 | 535.1022 | 619.2643 | 673.4581 | 664.7686 | 633.7254 | 582.4597 | 517.7074 | 437.2413 | 383.9640 | 371.1584 | (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 | 83.7242 | 83.8995 | 84.0720 | 84.8917 | 85.0469 | 85.7767 | 85.7767 | 85.9132 | 85.4941 | 85.0469 | 84.7336 | 84.4085 | |
| alpha | 6.5816 | 6.5933 | 6.6048 | 6.6594 | 6.6698 | 6.7184 | 6.7184 | 6.7275 | 6.6996 | 6.6698 | 6.6489 | 6.6272 | |
| util living area | | | | | | | | | | | | | |
| | 0.9988 | 0.9963 | 0.9847 | 0.9271 | 0.7736 | 0.5650 | 0.4110 | 0.4660 | 0.7511 | 0.9696 | 0.9969 | 0.9992 | (86) |
| MIT | 20.1535 | 20.2927 | 20.5228 | 20.7943 | 20.9521 | 20.9948 | 20.9995 | 20.9988 | 20.9705 | 20.7298 | 20.3839 | 20.1254 | (87) |
| Th 2 | 20.2279 | 20.2294 | 20.2308 | 20.2377 | 20.2390 | 20.2450 | 20.2450 | 20.2461 | 20.2427 | 20.2390 | 20.2364 | 20.2337 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9984 | 0.9952 | 0.9798 | 0.9059 | 0.7253 | 0.5009 | 0.3408 | 0.3904 | 0.6842 | 0.9565 | 0.9957 | 0.9989 | (89) |
| MIT 2 | 19.4450 | 19.5850 | 19.8134 | 20.0764 | 20.2088 | 20.2428 | 20.2449 | 20.2458 | 20.2274 | 20.0231 | 19.6823 | 19.4219 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3516 | (91) |
| MIT | 19.6942 | 19.8339 | 20.0628 | 20.3288 | 20.4702 | 20.5072 | 20.5102 | 20.5106 | 20.4887 | 20.2716 | 19.9290 | 19.6693 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.6942 | 19.8339 | 20.0628 | 20.3288 | 20.4702 | 20.5072 | 20.5102 | 20.5106 | 20.4887 | 20.2716 | 19.9290 | 19.6693 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9981 | 0.9944 | 0.9785 | 0.9088 | 0.7406 | 0.5234 | 0.3655 | 0.4171 | 0.7069 | 0.9572 | 0.9951 | 0.9987 | (94) |
| Useful gains | 392.5517 | 455.8708 | 523.5913 | 562.7596 | 498.7669 | 347.9662 | 231.6527 | 242.9159 | 365.9860 | 418.5309 | 382.0699 | 370.6579 | (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 | | | | | | | | | | | | | |
| | 935.0425 | 905.1899 | 820.4010 | 684.6421 | 524.4155 | 350.2179 | 231.8238 | 243.3153 | 380.0190 | 578.3171 | 769.9512 | 931.9881 | (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) |
| Space heating kWh | | | | | | | | | | | | | |
| | 403.6131 | 301.9424 | 220.8264 | 87.7554 | 19.0825 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 118.8809 | 279.2745 | 417.6297 | (98) |
| Space heating | | | | | | | | | | | | 1849.0050 | (98) |
| Space heating per m2 | | | | | | | | | | | (98) / (4) = | 25.2493 | (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 | 557.2949 | 438.7215 | 449.8628 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.9807 | 0.9933 | 0.9884 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 546.5248 | 435.7653 | 444.6625 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 863.8713 | 825.8765 | 767.5582 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Month fracti | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103a) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 228.4895 | 290.2427 | 240.2344 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Space cooling | | | | | | | | | | | | 758.9666 | (104) |

## CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cooled fraction | | | | | | | | | fC = cooled area / (4) = | | | 1.0000 | (105) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500 | 0.2500 | 0.2500 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (106) |
| Space cooling kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 57.1224 | 72.5607 | 60.0586 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling | | | | | | | | | | | | 189.7416 | (107) |
| Space cooling per m2 | | | | | | | | | | | | 2.5910 | (108) |
| Energy for space heating | | | | | | | | | | | | 25.2493 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.5910 | (108) |
| Total | | | | | | | | | | | | 27.8403 | (109) |
| Dwelling Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 27.8 | (109) |

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## CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

### 1. Overall dwelling dimensions

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.2300 (1b) | x | 2.4000 (2b) | = | 175.7520 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 73.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 175.7520 | (5) |

### 2. Ventilation rate

| | main heating | | secondary heating | | other | | total | | m3 per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 * 40 = | | 0.0000 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 * 20 = | | 0.0000 | (6b) |
| Number of intermittent fans | | | | | | | 3 * 10 = | | 30.0000 | (7a) |
| Number of passive vents | | | | | | | 0 * 10 = | | 0.0000 | (7b) |
| Number of flueless gas fires | | | | | | | 0 * 40 = | | 0.0000 | (7c) |

| | | | |
|---|---|---|---|
| | | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1707 | (8) |
| Pressure test | | Yes | |
| Measured/design AP50 | | 5.0000 | |
| Infiltration rate | | 0.4207 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3260 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4157 | 0.4075 | 0.3994 | 0.3586 | 0.3505 | 0.3097 | 0.3097 | 0.3016 | 0.3260 | 0.3505 | 0.3668 | 0.3831 | (22b) |
| Effective ac | 0.5864 | 0.5830 | 0.5798 | 0.5643 | 0.5614 | 0.5480 | 0.5480 | 0.5455 | 0.5532 | 0.5614 | 0.5673 | 0.5734 | (25) |

### 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1200 | 1.0000 | 2.1200 | | | (26) |
| TER Opening Type (Uw = 1.40) | | | 10.2200 | 1.3258 | 13.5492 | | | (27) |
| WT-E-03 | 32.1100 | 10.2200 | 21.8900 | 0.1800 | 3.9402 | | | (29a) |
| WT-I-02 | 21.8400 | 2.1200 | 19.7200 | 0.1800 | 3.5496 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 53.9500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 23.1590 | | | (33) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 5.5327 | (36) |
| Total fabric heat loss | | | | | (33) + (36) = | | 28.6917 | (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 | 34.0103 | 33.8157 | 33.6250 | 32.7291 | 32.5615 | 31.7812 | 31.7812 | 31.6367 | 32.0817 | 32.5615 | 32.9005 | 33.2550 | (38) |
| Heat transfer coeff | 62.7020 | 62.5074 | 62.3167 | 61.4208 | 61.2532 | 60.4729 | 60.4729 | 60.3284 | 60.7735 | 61.2532 | 61.5923 | 61.9468 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 61.4200 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8562 | 0.8536 | 0.8510 | 0.8387 | 0.8364 | 0.8258 | 0.8258 | 0.8238 | 0.8299 | 0.8364 | 0.8411 | 0.8459 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8387 | (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.3219 | (42) |
| Average daily hot water use (litres/day) | 89.3456 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 98.2802 | 94.7063 | 91.1325 | 87.5587 | 83.9849 | 80.4110 | 80.4110 | 83.9849 | 87.5587 | 91.1325 | 94.7063 | 98.2802 | (44) |
| Energy conte | 145.7467 | 127.4710 | 131.5386 | 114.6785 | 110.0368 | 94.9534 | 87.9883 | 100.9678 | 102.1737 | 119.0736 | 129.9781 | 141.1478 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1405.7543 | (45) |
| Distribution loss (46)m = 0.15 x (45)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Total storage loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder contains dedicated solar storage | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |

## CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
Heat gains from water heating, kWh/month
                30.9712    27.0876    27.9520    24.3692    23.3828    20.1776    18.6975    21.4557    21.7119    25.3031    27.6204    29.9939 (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          116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960   116.0960 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                19.5929    17.4022    14.1524    10.7143     8.0091     6.7616     7.3061     9.4968    12.7466    16.1847    18.8899    20.1374 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               204.7153   206.8396   201.4864   190.0901   175.7044   162.1838   153.1512   151.0269   156.3801   167.7764   182.1621   195.6827 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096    34.6096 (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)
               -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768   -92.8768 (71)
Water heating gains (Table 5)
                41.6279    40.3089    37.5698    33.8461    31.4285    28.0244    25.1311    28.8383    30.1554    34.0096    38.3616    40.3144 (72)
Total internal gains
               323.7649   322.3795   311.0375   292.4793   272.9708   254.7986   243.4172   247.1908   257.1109   275.7995   297.2425   313.9633 (73)


---------------------------------------------------------------------------------------------------------------
6. Solar gains
---------------------------------------------------------------------------------------------------------------

[Jan]                                      Area        Solar flux              g              FF          Access            Gains
                                            m2          Table 6a     Specific data     Specific data      factor              W
                                                          W/m2       or Table 6b       or Table 6c     Table 6d
---------------------------------------------------------------------------------------------------------------
West                                     10.2200          19.6403          0.6300           0.7000        0.7700          61.3437 (80)
---------------------------------------------------------------------------------------------------------------

Solar gains     61.3437   120.0013   197.6251   288.2244   353.2298   361.5935   344.2518   295.7072   229.8461   142.3917    76.4884    50.4461 (83)
Total gains    385.1086   442.3808   508.6626   580.7037   626.2006   616.3922   587.6690   542.8980   486.9570   418.1911   373.7309   364.4094 (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            81.1045    81.3570    81.6060    82.7963    83.0229    84.0941    84.0941    84.2956    83.6782    83.0229    82.5658    82.0933
alpha           6.4070     6.4238     6.4404     6.5198     6.5349     6.6063     6.6063     6.6197     6.5785     6.5349     6.5044     6.4729
util living area
                0.9990     0.9971     0.9890     0.9481     0.8229     0.6168     0.4514     0.5082     0.7952     0.9771     0.9974     0.9993 (86)

MIT            20.1024    20.2337    20.4568    20.7381    20.9261    20.9907    20.9989    20.9978    20.9563    20.6893    20.3431    20.0814 (87)
Th 2           20.2049    20.2071    20.2094    20.2199    20.2219    20.2310    20.2310    20.2327    20.2275    20.2219    20.2179    20.2137 (88)
util rest of house
                0.9986     0.9962     0.9853     0.9313     0.7770     0.5475     0.3733     0.4250     0.7293     0.9666     0.9964     0.9990 (89)
MIT 2          19.3747    19.5075    19.7304    20.0099    20.1737    20.2269    20.2308    20.2321    20.2040    19.9700    19.6260    19.3612 (90)
Living area fraction                                                                                 fLA = Living area / (4) =      0.3516 (91)
MIT            19.6306    19.7628    19.9858    20.2660    20.4382    20.4954    20.5009    20.5013    20.4685    20.2230    19.8781    19.6144 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT   19.6306    19.7628    19.9858    20.2660    20.4382    20.4954    20.5009    20.5013    20.4685    20.2230    19.8781    19.6144 (93)


---------------------------------------------------------------------------------------------------------------
8. Space heating requirement
---------------------------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9983     0.9955     0.9841     0.9325     0.7906     0.5717     0.4008     0.4544     0.7511     0.9667     0.9958     0.9988 (94)
Useful gains  384.4501   440.4004   500.5553   541.4821   495.0477   352.4128   235.5570   246.6843   365.7765   404.2449   372.1795   363.9677 (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
               961.2586   929.0375   840.3928   698.1071   535.2447   356.5144   235.8970   247.4277   387.0360   589.4371   787.0350   954.8752 (97)
Month fracti    1.0000     1.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000 (97a)
Space heating kWh
               429.1455   328.3642   252.8391   112.7700    29.9066     0.0000     0.0000     0.0000     0.0000   137.7830   298.6960   439.6352 (98)
Space heating                                                                                                                   2029.1396 (98)
Space heating per m2                                                                                                 (98) / (4) =     27.7091 (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   568.4453   447.4995   458.4959     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation     0.0000     0.0000     0.0000     0.0000     0.0000     0.9687     0.9884     0.9813     0.0000     0.0000     0.0000     0.0000 (101)
Useful loss     0.0000     0.0000     0.0000     0.0000     0.0000   550.6420   442.2918   449.9029     0.0000     0.0000     0.0000     0.0000 (102)
Total gains     0.0000     0.0000     0.0000     0.0000     0.0000   807.3274   772.0444   721.3172     0.0000     0.0000     0.0000     0.0000 (103)
Month fracti    0.0000     0.0000     0.0000     0.0000     0.0000     1.0000     1.0000     1.0000     0.0000     0.0000     0.0000     0.0000 (103a)
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000   184.8135   245.3359   201.9322     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                   632.0817 (104)
Cooled fraction                                                                                      fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
```

## CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 46.2034 | 61.3340 | 50.4831 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling | | | | | | | | | | | | 158.0204 | (107) |
| Space cooling per m2 | | | | | | | | | | | | 2.1579 | (108) |
| Energy for space heating | | | | | | | | | | | | 27.7091 | (99) |
| Energy for space cooling | | | | | | | | | | | | 2.1579 | (108) |
| Total | | | | | | | | | | | | 29.8670 | (109) |
| Target Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 34.3 | (109) |

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## CALCULATION OF HEAT DEMAND 09 Jan 2014

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

### 1. Overall dwelling dimensions

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.2300 (1b) | x | 2.4000 (2b) | = | 175.7520 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 73.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 175.7520 | (5) |

### 2. Ventilation rate

| | main heating | | secondary heating | | other | | total | | m3 per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 * 40 = | | 0.0000 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 * 20 = | | 0.0000 | (6b) |
| Number of intermittent 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)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Measured/design AP50 | | 3.3800 | |
| Infiltration rate | | 0.1690 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1310 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 4.2000 | 4.0000 | 4.0000 | 3.7000 | 3.7000 | 3.3000 | 3.4000 | 3.2000 | 3.3000 | 3.5000 | 3.5000 | 3.8000 | (22) |
| Wind factor | 1.0500 | 1.0000 | 1.0000 | 0.9250 | 0.9250 | 0.8250 | 0.8500 | 0.8000 | 0.8250 | 0.8750 | 0.8750 | 0.9500 | (22a) |
| Adj infilt rate | 0.1375 | 0.1310 | 0.1310 | 0.1212 | 0.1212 | 0.1081 | 0.1113 | 0.1048 | 0.1081 | 0.1146 | 0.1146 | 0.1244 | (22b) |

Mechanical extract ventilation - decentralised

| | | |
|---|---|---|
| If mechanical ventilation: | 0.5000 | (23a) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Opening Type 1 | | | 2.1200 | 1.0000 | 2.1200 | | | (26) |
| Opening Type 2 (Uw = 1.30) | | | 10.2200 | 1.2357 | 12.6293 | | | (27) |
| WT-E-03 | 32.1100 | 10.2200 | 21.8900 | 0.1600 | 3.5024 | | | (29a) |
| WT-I-02 | 21.8400 | 2.1200 | 19.7200 | 0.1584 | 3.1240 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 53.9500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 21.3757 | | | (33) |
| Party Wall 1 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Wall 2 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Floor 1 | | | 72.3300 | | | | | (32d) |
| Party Ceilings 1 | | | 73.2300 | | | | | (32b) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 7.0980 | (36) |
| Total fabric heat loss (33) + (36) = | 28.4737 | (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 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | (38) |
| Heat transfer coeff | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 57.4728 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7848 | (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.3219 | (42) |
| Average daily hot water use (litres/day) | 89.3456 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 98.2802 | 94.7063 | 91.1325 | 87.5587 | 83.9849 | 80.4110 | 80.4110 | 83.9849 | 87.5587 | 91.1325 | 94.7063 | 98.2802 | (44) |
| Energy conte | 145.7467 | 127.4710 | 131.5386 | 114.6785 | 110.0368 | 94.9534 | 87.9883 | 100.9678 | 102.1737 | 119.0736 | 129.9781 | 141.1478 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1405.7543 | (45) |

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

## CALCULATION OF HEAT DEMAND 09 Jan 2014

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21.8620 | 19.1206 | 19.7308 | 17.2018 | 16.5055 | 14.2430 | 13.1982 | 15.1452 | 15.3261 | 17.8610 | 19.4967 | 21.1722 | (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) |
| Combi loss | 14.1003 | 12.7150 | 14.0443 | 13.5538 | 13.9784 | 13.4960 | 13.9264 | 13.9601 | 13.5275 | 14.0170 | 13.6082 | 14.0895 | (61) |
| Total heat required for water heating calculated for each month | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (62) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63) |
| | | | | | | | | Solar input (sum of months) = Sum(63)m = | | | | 0.0000 | (63) |
| Output from w/h | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | | 1570.7708 | (64) |
| RHI water heating demand | | | | | | | | | | | | 1571 | (64) |
| Heat gains from water heating, kWh/month | 51.9858 | 45.5628 | 47.2477 | 41.5191 | 40.0818 | 34.9460 | 32.7377 | 37.0618 | 37.3546 | 43.0962 | 46.6198 | 50.4540 | (65) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 48.9821 | 43.5055 | 35.3811 | 26.7857 | 20.0227 | 16.9040 | 18.2653 | 23.7420 | 31.8664 | 40.4617 | 47.2248 | 50.3435 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 305.5452 | 308.7158 | 300.7260 | 283.7166 | 262.2454 | 242.0654 | 228.5839 | 225.4133 | 233.4031 | 250.4125 | 271.8838 | 292.0638 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | (71) |
| Water heating gains (Table 5) | 69.8734 | 67.8019 | 63.5049 | 57.6654 | 53.8734 | 48.5361 | 44.0023 | 49.8143 | 51.8814 | 57.9250 | 64.7497 | 67.8146 | (72) |
| Total internal gains | 525.0927 | 520.7150 | 500.3038 | 468.8596 | 436.8333 | 408.1973 | 391.5434 | 399.6614 | 417.8428 | 449.4911 | 484.5502 | 510.9137 | (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 | |
|---|---|---|---|---|---|---|---|
| West | 10.2200 | 22.3313 | 0.4500 | 0.0000 | 0.7700 | 79.0803 | (80) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 79.0803 | 139.1533 | 225.9604 | 338.6498 | 403.5155 | 441.7215 | 416.1196 | 366.0865 | 284.5456 | 176.2051 | 101.0154 | 64.4008 | (83) |
| Total gains | 604.1730 | 659.8683 | 726.2642 | 807.5094 | 840.3488 | 849.9189 | 807.6629 | 765.7479 | 702.3884 | 625.6962 | 585.5656 | 575.3145 | (84) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| tau | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | |
| alpha | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | |
| util living area | 0.9797 | 0.9628 | 0.9031 | 0.7514 | 0.5432 | 0.3380 | 0.2206 | 0.2402 | 0.4731 | 0.8011 | 0.9529 | 0.9844 | (86) |
| MIT | 20.5578 | 20.6568 | 20.8272 | 20.9571 | 20.9955 | 20.9999 | 21.0000 | 21.0000 | 20.9986 | 20.9464 | 20.7401 | 20.5226 | (87) |
| Th 2 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | (88) |
| util rest of house | 0.9741 | 0.9531 | 0.8811 | 0.7117 | 0.4950 | 0.2885 | 0.1684 | 0.1851 | 0.4140 | 0.7557 | 0.9388 | 0.9799 | (89) |
| MIT 2 | 19.8775 | 19.9725 | 20.1297 | 20.2375 | 20.2642 | 20.2665 | 20.2665 | 20.2665 | 20.2660 | 20.2319 | 20.0532 | 19.8435 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3516 | (91) |
| MIT | 20.1167 | 20.2131 | 20.3750 | 20.4906 | 20.5213 | 20.5243 | 20.5244 | 20.5244 | 20.5236 | 20.4831 | 20.2947 | 20.0823 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 19.9667 | 20.0631 | 20.2250 | 20.3406 | 20.3713 | 20.3743 | 20.3744 | 20.3744 | 20.3736 | 20.3331 | 20.1447 | 19.9323 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9713 | 0.9500 | 0.8798 | 0.7159 | 0.5019 | 0.2958 | 0.1761 | 0.1932 | 0.4227 | 0.7601 | 0.9361 | 0.9774 | (94) |
| Useful gains | 586.8534 | 626.8779 | 638.9430 | 578.0695 | 421.7794 | 251.3660 | 142.2112 | 147.9577 | 296.8838 | 475.6025 | 548.1394 | 562.3207 | (95) |
| Ext temp. | 5.1000 | 5.6000 | 7.4000 | 9.9000 | 13.0000 | 16.0000 | 17.9000 | 17.8000 | 15.2000 | 11.6000 | 8.0000 | 5.1000 | (96) |
| Heat loss rate W | 854.4310 | 831.2371 | 737.0890 | 600.0489 | 423.6510 | 251.4057 | 142.2119 | 147.9591 | 297.3400 | 501.9159 | 697.9914 | 852.4524 | (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) |
| Space heating kWh | 199.0777 | 137.3294 | 73.0206 | 15.8252 | 1.3925 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.5772 | 107.8934 | 215.8580 | (98) |
| Space heating | | | | | | | | | | | | 769.9740 | (98) |
| RHI space heating demand | | | | | | | | | | | | 770 | (98) |

## CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

### 1. Overall dwelling dimensions

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.2300 (1b) | x | 2.4000 (2b) | = | 175.7520 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 73.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 175.7520 | (5) |

### 2. Ventilation rate

| | main heating | | secondary heating | | other | | total | | m3 per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 * 40 = | | 0.0000 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 * 20 = | | 0.0000 | (6b) |
| Number of intermittent 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)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Measured/design AP50 | | 3.3800 | |
| Infiltration rate | | 0.1690 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1310 | (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 | 0.1670 | 0.1637 | 0.1604 | 0.1441 | 0.1408 | 0.1244 | 0.1244 | 0.1212 | 0.1310 | 0.1408 | 0.1473 | 0.1539 | (22b) |

Mechanical extract ventilation - decentralised

| | | |
|---|---|---|
| If mechanical ventilation: | 0.5000 | (23a) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Opening Type 1 | | | 2.1200 | 1.0000 | 2.1200 | | | (26) |
| Opening Type 2 (Uw = 1.30) | | | 10.2200 | 1.2357 | 12.6293 | | | (27) |
| WT-E-03 | 32.1100 | 10.2200 | 21.8900 | 0.1600 | 3.5024 | | | (29a) |
| WT-I-02 | 21.8400 | 2.1200 | 19.7200 | 0.1584 | 3.1240 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 53.9500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 21.3757 | | | (33) |
| Party Wall 1 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Wall 2 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Floor 1 | | | 72.3300 | | | | | (32d) |
| Party Ceilings 1 | | | 73.2300 | | | | | (32b) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 7.0980 | (36) |
| Total fabric heat loss (33) + (36) = | 28.4737 | (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 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | (38) |
| Heat transfer coeff | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 57.4728 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7848 | (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.3219 | (42) |
| Average daily hot water use (litres/day) | 89.3456 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 98.2802 | 94.7063 | 91.1325 | 87.5587 | 83.9849 | 80.4110 | 80.4110 | 83.9849 | 87.5587 | 91.1325 | 94.7063 | 98.2802 | (44) |
| Energy conte | 145.7467 | 127.4710 | 131.5386 | 114.6785 | 110.0368 | 94.9534 | 87.9883 | 100.9678 | 102.1737 | 119.0736 | 129.9781 | 141.1478 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1405.7543 | (45) |

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

## CALCULATION OF ENERGY RATINGS 09 Jan 2014

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21.8620 | 19.1206 | 19.7308 | 17.2018 | 16.5055 | 14.2430 | 13.1982 | 15.1452 | 15.3261 | 17.8610 | 19.4967 | 21.1722 | (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) |
| Combi loss | 14.1003 | 12.7150 | 14.0443 | 13.5538 | 13.9784 | 13.4960 | 13.9264 | 13.9601 | 13.5275 | 14.0170 | 13.6082 | 14.0895 | (61) |
| Total heat required for water heating calculated for each month | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (62) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63) |
| | | | | | | | | Solar input (sum of months) = Sum(63)m = | | | | 0.0000 | (63) |
| Output from w/h | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | | 1570.7708 | (64) |
| Heat gains from water heating, kWh/month | 51.9858 | 45.5628 | 47.2477 | 41.5191 | 40.0818 | 34.9460 | 32.7377 | 37.0618 | 37.3546 | 43.0962 | 46.6198 | 50.4540 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 48.9821 | 43.5055 | 35.3811 | 26.7857 | 20.0227 | 16.9040 | 18.2653 | 23.7420 | 31.8664 | 40.4617 | 47.2248 | 50.3435 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 305.5452 | 308.7158 | 300.7260 | 283.7166 | 262.2454 | 242.0654 | 228.5839 | 225.4133 | 233.4031 | 250.4125 | 271.8838 | 292.0638 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | (71) |
| Water heating gains (Table 5) | 69.8734 | 67.8019 | 63.5049 | 57.6654 | 53.8734 | 48.5361 | 44.0023 | 49.8143 | 51.8814 | 57.9250 | 64.7497 | 67.8146 | (72) |
| Total internal gains | 525.0927 | 520.7150 | 500.3038 | 468.8596 | 436.8333 | 408.1973 | 391.5434 | 399.6614 | 417.8428 | 449.4911 | 484.5502 | 510.9137 | (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 | |
|---|---|---|---|---|---|---|---|
| West | 10.2200 | 19.6403 | 0.4500 | 0.0000 | 0.7700 | 69.5507 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 69.5507 | 136.0559 | 224.0647 | 326.7850 | 400.4873 | 409.9700 | 390.3082 | 335.2689 | 260.5965 | 161.4418 | 86.7215 | 57.1951 | (83) |
| Total gains | 594.6434 | 656.7709 | 724.3685 | 795.6446 | 837.3206 | 818.1673 | 781.8515 | 734.9303 | 678.4393 | 610.9329 | 571.2717 | 568.1088 | (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 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | |
| alpha | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | |
| util living area | 0.9857 | 0.9708 | 0.9257 | 0.8076 | 0.6276 | 0.4486 | 0.3233 | 0.3595 | 0.5785 | 0.8636 | 0.9697 | 0.9892 | (86) |
| MIT | 20.4866 | 20.6047 | 20.7763 | 20.9274 | 20.9876 | 20.9989 | 20.9999 | 20.9998 | 20.9943 | 20.9037 | 20.6635 | 20.4456 | (87) |
| Th 2 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | (88) |
| util rest of house | 0.9818 | 0.9632 | 0.9085 | 0.7733 | 0.5817 | 0.3976 | 0.2695 | 0.3023 | 0.5195 | 0.8283 | 0.9605 | 0.9862 | (89) |
| MIT 2 | 19.8079 | 19.9223 | 20.0836 | 20.2143 | 20.2592 | 20.2660 | 20.2665 | 20.2664 | 20.2639 | 20.1985 | 19.9807 | 19.7676 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3516 | (91) |
| MIT | 20.0465 | 20.1623 | 20.3272 | 20.4650 | 20.5154 | 20.5237 | 20.5244 | 20.5243 | 20.5207 | 20.4464 | 20.2208 | 20.0060 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 19.8965 | 20.0123 | 20.1772 | 20.3150 | 20.3654 | 20.3737 | 20.3744 | 20.3743 | 20.3707 | 20.2964 | 20.0708 | 19.8560 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9794 | 0.9602 | 0.9061 | 0.7757 | 0.5880 | 0.4051 | 0.2774 | 0.3107 | 0.5280 | 0.8299 | 0.9576 | 0.9841 | (94) |
| Useful gains | 582.3665 | 630.6067 | 656.3635 | 617.1660 | 492.3285 | 331.4418 | 216.9012 | 228.3655 | 358.2312 | 506.9939 | 547.0266 | 559.0960 | (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 | 896.3763 | 868.5436 | 786.0660 | 656.0543 | 498.0233 | 331.8322 | 216.9238 | 228.4151 | 360.3956 | 557.2819 | 745.4681 | 899.7956 | (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) |
| Space heating kWh | 233.6233 | 159.8936 | 96.4986 | 27.9996 | 4.2369 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 37.4143 | 142.8779 | 253.4805 | (98) |
| Space heating | | | | | | | | | | | | 956.0249 | (98) |
| Space heating per m2 | | | | | | | | | | | (98) / (4) = | 13.0551 | (99) |

### 8c. Space cooling requirement

Not applicable

**CALCULATION OF ENERGY RATINGS 09 Jan 2014**

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

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| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 90.5000 | (206) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |
| Space heating requirement | 1056.3811 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 233.6233 | 159.8936 | 96.4986 | 27.9996 | 4.2369 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 37.4143 | 142.8779 | 253.4805 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 258.1473 | 176.6780 | 106.6283 | 30.9388 | 4.6817 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.3418 | 157.8762 | 280.0890 | (211) |
| Water heating requirement | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 87.3000 | (216) |
| (217)m | 89.1721 | 88.9764 | 88.5481 | 87.8567 | 87.4021 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 87.9827 | 88.8672 | 89.2573 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 179.2567 | 157.5541 | 164.4111 | 145.9562 | 141.8904 | 124.2262 | 116.7407 | 131.6471 | 132.5329 | 151.2691 | 161.5740 | 173.9211 | (219) |
| Water heating fuel used | | | | | | | | | | | | 1780.9795 | (219) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system | 1056.3811 | (211) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Electricity for pumps and fans: | | |
| (MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840) | | |
| mechanical ventilation fans (SFP = 0.1840) | 39.4528 | (230a) |
| central heating pump | 30.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 114.4528 | (231) |
| Electricity for lighting (calculated in Appendix L) | 346.0160 | (232) |
| Total delivered energy for all uses | 3297.8294 | (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 | 1056.3811 | 3.4800 | 36.7621 | (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (242) |
| Water heating (other fuel) | 1780.9795 | 3.4800 | 61.9781 | (247) |
| Mechanical ventilation fans | 39.4528 | 13.1900 | 5.2038 | (249) |
| Pumps and fans for heating | 75.0000 | 13.1900 | 9.8925 | (249) |
| Energy for lighting | 346.0160 | 13.1900 | 45.6395 | (250) |
| Additional standing charges | | | 120.0000 | (251) |
| Total energy cost | | | 279.4760 | (255) |

---

11a. SAP rating - Individual heating systems

---

| | | | |
|---|---|---|---|
| Energy cost deflator (Table 12): | | 0.4200 | (256) |
| Energy cost factor (ECF) | [(255) x (256)] / [(4) + 45.0] = | 0.9928 | (257) |
| SAP value | | 86.1503 | |
| SAP rating (Section 12) | | 86 | (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 | 1056.3811 | 0.2160 | 228.1783 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 1780.9795 | 0.2160 | 384.6916 | (264) |
| Space and water heating | | | 612.8699 | (265) |
| Pumps and fans | 114.4528 | 0.5190 | 59.4010 | (267) |
| Energy for lighting | 346.0160 | 0.5190 | 179.5823 | (268) |
| Total kg/year | | | 851.8532 | (272) |
| CO2 emissions per m2 | | | 11.6300 | (273) |
| EI value | | | 90.3452 | |
| EI rating | | | 90 | (274) |
| EI band | | | B | |

---

Calculation of stars for heating and DHW

---

| | |
|---|---|
| Main heating energy efficiency | 3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4 |
| Main heating environmental impact | 0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4 |
| Water heating energy efficiency | 3.48 / 0.8811 = 3.950, stars = 4 |
| Water heating environmental impact | 0.216 / 0.8811 = 0.2452, stars = 4 |

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

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

### 1. Overall dwelling dimensions

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 73.2300 (1b) | x | 2.4000 (2b) | = | 175.7520 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 73.2300 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 175.7520 | (5) |

### 2. Ventilation rate

| | main heating | | secondary heating | | other | | total | | m3 per hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of chimneys | 0 | + | 0 | + | 0 | = | 0 * 40 = | | 0.0000 | (6a) |
| Number of open flues | 0 | + | 0 | + | 0 | = | 0 * 20 = | | 0.0000 | (6b) |
| Number of intermittent 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)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | | 0.0000 | (8) |
| Pressure test | | | Yes | |
| Measured/design AP50 | | | 3.3800 | |
| Infiltration rate | | | 0.1690 | (18) |
| Number of sides sheltered | | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | | 0.1310 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 4.2000 | 4.0000 | 4.0000 | 3.7000 | 3.7000 | 3.3000 | 3.4000 | 3.2000 | 3.3000 | 3.5000 | 3.5000 | 3.8000 | (22) |
| Wind factor | 1.0500 | 1.0000 | 1.0000 | 0.9250 | 0.9250 | 0.8250 | 0.8500 | 0.8000 | 0.8250 | 0.8750 | 0.8750 | 0.9500 | (22a) |
| Adj infilt rate | 0.1375 | 0.1310 | 0.1310 | 0.1212 | 0.1212 | 0.1081 | 0.1113 | 0.1048 | 0.1081 | 0.1146 | 0.1146 | 0.1244 | (22b) |

Mechanical extract ventilation - decentralised

| | | |
|---|---|---|
| If mechanical ventilation: | 0.5000 | (23a) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | (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 | |
|---|---|---|---|---|---|---|---|---|
| Opening Type 1 | | | 2.1200 | 1.0000 | 2.1200 | | | (26) |
| Opening Type 2 (Uw = 1.30) | | | 10.2200 | 1.2357 | 12.6293 | | | (27) |
| WT-E-03 | 32.1100 | 10.2200 | 21.8900 | 0.1600 | 3.5024 | | | (29a) |
| WT-I-02 | 21.8400 | 2.1200 | 19.7200 | 0.1584 | 3.1240 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 53.9500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 21.3757 | | | (33) |
| Party Wall 1 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Wall 2 | | | 17.7000 | 0.0000 | 0.0000 | | | (32) |
| Party Floor 1 | | | 72.3300 | | | | | (32d) |
| Party Ceilings 1 | | | 73.2300 | | | | | (32b) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 7.0980 | (36) |
| Total fabric heat loss (33) + (36) = | 28.4737 | (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 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | 28.9991 | (38) |
| Heat transfer coeff | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | 57.4728 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 57.4728 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | 0.7848 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7848 | (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |

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

| | | |
|---|---|---|
| Assumed occupancy | 2.3219 | (42) |
| Average daily hot water use (litres/day) | 89.3456 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 98.2802 | 94.7063 | 91.1325 | 87.5587 | 83.9849 | 80.4110 | 80.4110 | 83.9849 | 87.5587 | 91.1325 | 94.7063 | 98.2802 | (44) |
| Energy conte | 145.7467 | 127.4710 | 131.5386 | 114.6785 | 110.0368 | 94.9534 | 87.9883 | 100.9678 | 102.1737 | 119.0736 | 129.9781 | 141.1478 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1405.7543 | (45) |

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21.8620 | 19.1206 | 19.7308 | 17.2018 | 16.5055 | 14.2430 | 13.1982 | 15.1452 | 15.3261 | 17.8610 | 19.4967 | 21.1722 | (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) |
| Combi loss | 14.1003 | 12.7150 | 14.0443 | 13.5538 | 13.9784 | 13.4960 | 13.9264 | 13.9601 | 13.5275 | 14.0170 | 13.6082 | 14.0895 | (61) |
| Total heat required for water heating calculated for each month | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (62) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63) |
| | | | | | | | | Solar input (sum of months) = Sum(63)m = | | | | 0.0000 | (63) |
| Output from w/h | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | | 1570.7708 | (64) |
| Heat gains from water heating, kWh/month | 51.9858 | 45.5628 | 47.2477 | 41.5191 | 40.0818 | 34.9460 | 32.7377 | 37.0618 | 37.3546 | 43.0962 | 46.6198 | 50.4540 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | 139.3152 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 48.9821 | 43.5055 | 35.3811 | 26.7857 | 20.0227 | 16.9040 | 18.2653 | 23.7420 | 31.8664 | 40.4617 | 47.2248 | 50.3435 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 305.5452 | 308.7158 | 300.7260 | 283.7166 | 262.2454 | 242.0654 | 228.5839 | 225.4133 | 233.4031 | 250.4125 | 271.8838 | 292.0638 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | 51.2534 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | -92.8768 | (71) |
| Water heating gains (Table 5) | 69.8734 | 67.8019 | 63.5049 | 57.6654 | 53.8734 | 48.5361 | 44.0023 | 49.8143 | 51.8814 | 57.9250 | 64.7497 | 67.8146 | (72) |
| Total internal gains | 525.0927 | 520.7150 | 500.3038 | 468.8596 | 436.8333 | 408.1973 | 391.5434 | 399.6614 | 417.8428 | 449.4911 | 484.5502 | 510.9137 | (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 | |
|---|---|---|---|---|---|---|---|
| West | 10.2200 | 22.3313 | 0.4500 | 0.0000 | 0.7700 | 79.0803 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 79.0803 | 139.1533 | 225.9604 | 338.6498 | 403.5155 | 441.7215 | 416.1196 | 366.0865 | 284.5456 | 176.2051 | 101.0154 | 64.4008 | (83) |
| Total gains | 604.1730 | 659.8683 | 726.2642 | 807.5094 | 840.3488 | 849.9189 | 807.6629 | 765.7479 | 702.3884 | 625.6962 | 585.5656 | 575.3145 | (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 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | 88.4839 | |
| alpha | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | 6.8989 | |
| util living area | 0.9797 | 0.9628 | 0.9031 | 0.7514 | 0.5432 | 0.3380 | 0.2206 | 0.2402 | 0.4731 | 0.8011 | 0.9529 | 0.9844 | (86) |
| MIT | 20.5578 | 20.6568 | 20.8272 | 20.9571 | 20.9955 | 20.9999 | 21.0000 | 21.0000 | 20.9986 | 20.9464 | 20.7401 | 20.5226 | (87) |
| Th 2 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | 20.2665 | (88) |
| util rest of house | 0.9741 | 0.9531 | 0.8811 | 0.7117 | 0.4950 | 0.2885 | 0.1684 | 0.1851 | 0.4140 | 0.7557 | 0.9388 | 0.9799 | (89) |
| MIT 2 | 19.8775 | 19.9725 | 20.1297 | 20.2375 | 20.2642 | 20.2665 | 20.2665 | 20.2665 | 20.2660 | 20.2319 | 20.0532 | 19.8435 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3516 | (91) |
| MIT | 20.1167 | 20.2131 | 20.3750 | 20.4906 | 20.5213 | 20.5243 | 20.5244 | 20.5244 | 20.5236 | 20.4831 | 20.2947 | 20.0823 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 19.9667 | 20.0631 | 20.2250 | 20.3406 | 20.3713 | 20.3743 | 20.3744 | 20.3744 | 20.3736 | 20.3331 | 20.1447 | 19.9323 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9713 | 0.9500 | 0.8798 | 0.7159 | 0.5019 | 0.2958 | 0.1761 | 0.1932 | 0.4227 | 0.7601 | 0.9361 | 0.9774 | (94) |
| Useful gains | 586.8534 | 626.8779 | 638.9430 | 578.0695 | 421.7794 | 251.3660 | 142.2112 | 147.9577 | 296.8838 | 475.6025 | 548.1394 | 562.3207 | (95) |
| Ext temp. | 5.1000 | 5.6000 | 7.4000 | 9.9000 | 13.0000 | 16.0000 | 17.9000 | 17.8000 | 15.2000 | 11.6000 | 8.0000 | 5.1000 | (96) |
| Heat loss rate W | 854.4310 | 831.2371 | 737.0890 | 600.0489 | 423.6510 | 251.4057 | 142.2119 | 147.9591 | 297.3400 | 501.9159 | 697.9914 | 852.4524 | (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) |
| Space heating kWh | 199.0777 | 137.3294 | 73.0206 | 15.8252 | 1.3925 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.5772 | 107.8934 | 215.8580 | (98) |
| Space heating | | | | | | | | | | | | 769.9740 | (98) |
| Space heating per m2 | | | | | | | | | | (98) / (4) = | | 10.5145 | (99) |

### 8c. Space cooling requirement

Not applicable

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

### 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 %) | 90.5000 | (206) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |
| Space heating requirement | 850.8000 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 199.0777 | 137.3294 | 73.0206 | 15.8252 | 1.3925 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.5772 | 107.8934 | 215.8580 | (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | 219.9754 | 151.7451 | 80.6858 | 17.4864 | 1.5387 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 21.6323 | 119.2193 | 238.5171 | (211) |
| Water heating requirement | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 159.8470 | 140.1860 | 145.5829 | 128.2323 | 124.0151 | 108.4494 | 101.9146 | 114.9279 | 115.7012 | 133.0906 | 143.5864 | 155.2373 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 87.3000 | (216) |
| (217)m | 89.0464 | 88.8547 | 88.3434 | 87.6404 | 87.3343 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 87.6976 | 88.6448 | 89.1333 | (217) |
| Fuel for water heating, kWh/month | 179.5098 | 157.7698 | 164.7919 | 146.3164 | 142.0005 | 124.2262 | 116.7407 | 131.6471 | 132.5329 | 151.7607 | 161.9795 | 174.1632 | (219) |
| Water heating fuel used | | | | | | | | | | | | 1783.4388 | (219) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system | 850.8000 | (211) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Electricity for pumps and fans: | | |
| (MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840) | | |
| mechanical ventilation fans (SFP = 0.1840) | 39.4528 | (230a) |
| central heating pump | 30.0000 | (230c) |
| main heating flue fan | 45.0000 | (230e) |
| Total electricity for the above, kWh/year | 114.4528 | (231) |
| Electricity for lighting (calculated in Appendix L) | 346.0160 | (232) |
| Total delivered energy for all uses | 3094.7077 | (238) |

### 10a. Fuel costs - using BEDF prices (476)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 850.8000 | 3.8700 | 32.9260 | (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (242) |
| Water heating (other fuel) | 1783.4388 | 3.8700 | 69.0191 | (247) |
| Mechanical ventilation fans | 39.4528 | 18.9000 | 7.4566 | (249) |
| Pumps and fans for heating | 75.0000 | 18.9000 | 14.1750 | (249) |
| Energy for lighting | 346.0160 | 18.9000 | 65.3970 | (250) |
| Additional standing charges | | | 93.0000 | (251) |
| Total energy cost | | | 281.9737 | (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 | 850.8000 | 0.2160 | 183.7728 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 1783.4388 | 0.2160 | 385.2228 | (264) |
| Space and water heating | | | 568.9956 | (265) |
| Pumps and fans | 114.4528 | 0.5190 | 59.4010 | (267) |
| Energy for lighting | 346.0160 | 0.5190 | 179.5823 | (268) |
| Total kg/year | | | 807.9789 | (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 | 850.8000 | 1.2200 | 1037.9760 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 1783.4388 | 1.2200 | 2175.7954 | (264) |
| Space and water heating | | | 3213.7714 | (265) |
| Pumps and fans | 114.4528 | 3.0700 | 351.3701 | (267) |
| Energy for lighting | 346.0160 | 3.0700 | 1062.2692 | (268) |
| Primary energy kWh/year | | | 4627.4107 | (272) |
| Primary energy kWh/m2/year | | | 63.1901 | (273) |

### SAP 2012 EPC IMPROVEMENTS

| | |
|---|---|
| Current energy efficiency rating: | B 86 |
| Current environmental impact rating: | B 90 |

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

(For testing purposes):

| | | |
|---|---|---|
| A | | Not considered |
| B | | Not considered |
| C | | Not considered |
| D | | Not considered |
| E | Low energy lighting | Already installed |
| F | | Not considered |
| G | | Not considered |
| H | | Not considered |
| I | | Not considered |
| J | | Not considered |
| K | | Not considered |
| M | | Not considered |
| N | Solar water heating | Not applicable |
| O | | Not considered |
| P | | Not considered |
| R | | Not considered |
| S | | Not considered |
| T | | Not considered |
| U | Solar photovoltaic panels | Not applicable |
| A2 | | Not considered |
| A3 | | Not considered |
| T2 | | Not considered |
| W | | Not considered |
| X | | Not considered |
| Y | | Not considered |
| J2 | | Not considered |
| Q2 | | Not considered |
| Z1 | | Not considered |
| Z2 | | Not considered |
| Z3 | | Not considered |
| Z4 | | Not considered |
| Z5 | | Not considered |
| V2 | Wind turbine | Not applicable |
| L2 | | Not considered |
| Q3 | | Not considered |
| O3 | | Not considered |

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

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

Potential energy efficiency rating: B 86
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 476 TEST (01 Apr 2021)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

| | Current | Potential | Saving |
|---|---|---|---|
| Electricity | £87 | £87 | £0 |
| Mains gas | £195 | £195 | £0 |
| Space heating | £148 | £148 | £0 |
| Water heating | £69 | £69 | £0 |
| Lighting | £65 | £65 | £0 |
| Total cost of fuels | £282 | £282 | £0 |
| Total cost of uses | £282 | £282 | £0 |
| Delivered energy | 42 kWh/m² | 42 kWh/m² | 0 kWh/m² |
| Carbon dioxide emissions | 0.8 tonnes | 0.8 tonnes | 0.0 tonnes |
| CO2 emissions per m² | 11 kg/m² | 11 kg/m² | 0 kg/m² |
| Primary energy | 63 kWh/m² | 63 kWh/m² | 0 kWh/m² |

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

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-----------------------------------------------------------------------------------------------------
SAP 2012 WORKSHEET FOR New Build (As Built)   (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable


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```

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

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Built) 9.92

Overheating Calculation Input Data

| | |
|---|---|
| Dwelling type | MidTerrace Flat |
| Number of storeys | 1 |
| Cross ventilation possible | Yes |
| SAP Region | Thames Valley |
| Front of dwelling faces | East |
| Overshading | Average or unknown |
| Thermal mass parameter | 250.0 |
| Night ventilation | Yes |
| Ventilation rate during hot weather (ach) | 6.00 (Windows fully open) |

Overheating Calculation

| | | |
|---|---|---|
| Summer ventilation heat loss coefficient | 347.99 | (P1) |
| Transmission heat loss coefficient | 28.47 | (37) |
| Summer heat loss coefficient | 376.46 | (P2) |

Overhangs

| Orientation | Ratio | Z_overhangs | Overhang type |
|---|---|---|---|
| West | 0.000 | 1.000 | None |

Solar shading

| Orientation | Z blinds | Solar access | Z overhangs | Z summer | |
|---|---|---|---|---|---|
| West | 1.000 | 0.90 | 1.000 | 0.900 | (P8) |

| [Jul] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Shading | Gains W |
|---|---|---|---|---|---|---|
| West | 10.2200 | 117.5071 | 0.4500 | 0.0000 | 0.9000 | 486.3735 |
| total: | | | | | | 486.3735 |

| | Jun | Jul | Aug | |
|---|---|---|---|---|
| Solar gains | 516 | 486 | 428 | (P4) |
| Internal gains | 405 | 389 | 397 | |
| Total summer gains | 921 | 875 | 825 | (P5) |
| Summer gain/loss ratio | 2.45 | 2.32 | 2.19 | (P6) |
| Summer external temperature | 16.00 | 17.90 | 17.80 | |
| Thermal mass temperature increment (TMP = 250.0) | 0.25 | 0.25 | 0.25 | |
| Threshold temperature | 18.70 | 20.47 | 20.24 | (P7) |
| Likelihood of high internal temperature | Not significant | Not significant | Not significant | |

Assessment of likelihood of high internal temperature: Not significant