

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



| | | | | | |
|--|--|-----------------------|--------|-----------------------|------------|
| Property Reference | BD23 6RR Plot 28 | | | Issued on Date | 20/07/2022 |
| Assessment Reference | 001 | Prop Type Ref | Type A | | |
| Property | Plot 28, Phase 3, Shires Lane, Embsay, Skipton, BD23 6RR | | | | |
| SAP Rating | 89 B | DER | 11.52 | TER | 19.78 |
| Environmental | 92 A | % DER<TER | 41.75 | | |
| CO₂ Emissions (t/year) | 0.94 | DFEE | 58.18 | TFEE | 59.56 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 2.30 | | |
| Assessor Details | Mr. Jake Eaton, Jake Eaton, Tel: 01400283471, jake@eratech.co.uk | | | Assessor ID | P711-0001 |
| Client | | | | | |

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 83 m²

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

1a TER and DER

Fuel for main heating: Mains gas
Fuel factor: 1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.78 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.52 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 59.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 58.2 kWh/m²/yrOK

2 Fabric U-values

| Element | Average | Highest | |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall | 0.00 (max. 0.20) | - | OK |
| Floor | 0.17 (max. 0.25) | 0.18 (max. 0.70) | OK |
| Roof | 0.13 (max. 0.20) | 0.13 (max. 0.35) | OK |
| Openings | 1.63 (max. 2.00) | 1.80 (max. 3.30) | OK |

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from manufacturer rated a

Combi boiler
Efficiency: 90%
Minimum: 88% OK

Secondary heating system: Room heaters - Wood Logs

Closed room heater

Efficiency: 65%
Minimum: 65% OK

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

7 Low energy lights

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

8 Mechanical ventilation

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

9 Summertime temperature

Overheating risk (North East England): Not significant OK

Based on:

Overshading: Average
Windows facing East: 8.27 m², No overhang
Windows facing South: 0.68 m², No overhang
Windows facing West: 3.87 m², No overhang
Air change rate: 2.50 ach
Blinds/curtains: Light-coloured curtain or roller blind, closed 50% of daylight hours

10 Key features

Party wall U-value 0.00 W/m²K
Secondary heating (wood logs)
Secondary heating fuel: wood logs
Photovoltaic array 1.50 kW

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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 | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-----------------------------|---------------------------|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.2500 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | (21) = (18) x (20) = | 0.2125 (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 | 0.2709 | 0.2656 | 0.2603 | 0.2338 | 0.2284 | 0.2019 | 0.2019 | 0.1966 | 0.2125 | 0.2284 | 0.2391 | 0.2497 (22b) |
| Mechanical extract ventilation - decentralised | | | | | | | | | | | | 0.5000 (23a) |
| If mechanical ventilation: | | | | | | | | | | | | 0.5000 (23a) |
| Effective ac | 0.5209 | 0.5156 | 0.5103 | 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 | 1.8000 | 3.8160 | | (26a) |
| Opening Type 2 (Uw = 1.60) | | | 12.8200 | 1.5038 | 19.2782 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1400 | 1.1550 | 75.0000 | 618.7500 (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1838 | 5.7241 | 20.0000 | 623.0000 (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | 110.0000 | 9802.1000 (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1524 | 2.0999 | 110.0000 | 1515.8000 (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | 9.0000 | 354.6000 (30) |
| Total net area of external elements Aum(A, m2) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 53.2350 | | (33) |
| Party Wall 1 | | | 65.8300 | 0.0000 | 0.0000 | 70.0000 | 4608.1000 (32) |
| Internal Wall 2 | | | 76.5100 | | | 9.0000 | 688.5900 (32c) |
| Internal Floor 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32d) |
| Internal Ceiling 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32e) |
| Heat capacity Cm = Sum(A x k) | | | | | | (28)...(30) + (32) + (32a)...(32e) = | 19628.6200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 236.7176 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 22.8919 (36) |
| Total fabric heat loss | | | | | | (33) + (36) = | 76.1269 (37) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | 35.7076 | 35.3435 | 34.9793 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 (38) |
| Heat transfer coeff | 111.8345 | 111.4703 | 111.1062 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 110.6671 (39) |
| HLP | 1.3487 | 1.3443 | 1.3399 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 (40) |
| HLP (average) | | | | | | | | | | | | 1.3346 (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 | 2.5159 (42) |
| Average daily hot water use (litres/day) | 93.9534 (43) |

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|-----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |
| Energy conte | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (45) |
| Energy content (annual) | Total = Sum(45)m = 1478.2535 (45) | | | | | | | | | | | |
| Distribution loss (46)m = 0.15 x (45)m | 22.9895 | 20.1068 | 20.7484 | 18.0889 | 17.3568 | 14.9776 | 13.8789 | 15.9263 | 16.1165 | 18.7822 | 20.5022 | 22.2641 (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 | 50.9589 | 45.8390 | 48.8352 | 45.4065 | 45.0050 | 41.6999 | 43.0899 | 45.0050 | 45.4065 | 48.8352 | 49.1132 | 50.9589 (61) |
| Total heat required for water heating calculated for each month | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (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) |
| Output from w/h | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (64) |
| Heat gains from water heating, kWh/month | 63.6998 | 56.0297 | 58.2010 | 51.4488 | 49.7254 | 43.6252 | 41.5374 | 46.5545 | 47.0765 | 53.8427 | 57.7249 | 62.0918 (65) |
| Total per year (kWh/year) = Sum(64)m = 2038.4067 (64) | | | | | | | | | | | | |

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

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| (66)m | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 20.8275 | 18.4988 | 15.0443 | 11.3895 | 8.5138 | 7.1877 | 7.7665 | 10.0952 | 13.5498 | 17.2046 | 20.0803 | 21.4064 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 225.4349 | 227.7742 | 221.8792 | 209.3295 | 193.4877 | 178.5987 | 168.6519 | 166.3126 | 172.2076 | 184.7573 | 200.5991 | 215.4881 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 (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) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 (71) |
| Water heating gains (Table 5) | 85.6180 | 83.3776 | 78.2272 | 71.4566 | 66.8352 | 60.5906 | 55.8298 | 62.5732 | 65.3840 | 72.3692 | 80.1735 | 83.4567 (72) |
| Total internal gains | 395.6194 | 393.3896 | 378.8897 | 355.9146 | 332.5757 | 310.1160 | 295.9873 | 302.7200 | 314.8804 | 338.0701 | 364.5919 | 384.0902 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| East | 8.2700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 64.1595 (76) | | | | | | |
| South | 0.6800 | 46.7521 | 0.7600 | 0.7500 | 0.7700 | 12.5579 (78) | | | | | | |
| West | 3.8700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 30.0238 (80) | | | | | | |
| Solar gains | 106.7413 | 204.8092 | 329.6196 | 472.1316 | 573.1823 | 584.8623 | 557.5557 | 482.1860 | 380.2587 | 240.8024 | 132.3210 | 88.3030 (83) |
| Total gains | 502.3606 | 598.1988 | 708.5092 | 828.0462 | 905.7581 | 894.9783 | 853.5430 | 784.9060 | 695.1391 | 578.8725 | 496.9128 | 472.3932 (84) |

7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) | 0.9972 | 0.9938 | 0.9830 | 0.9470 | 0.8581 | 0.7051 | 0.5461 | 0.6079 | 0.8462 | 0.9731 | 0.9946 | 0.9979 (86) |
| tau | 48.7541 | 48.9134 | 49.0737 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 (87) |
| alpha | 4.2503 | 4.2609 | 4.2716 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 (88) |
| MIT | 19.7686 | 19.9102 | 20.1539 | 20.4640 | 20.7231 | 20.8722 | 20.9201 | 20.9106 | 20.7882 | 20.4356 | 20.0452 | 19.7512 (89) |
| Th 2 | 19.8029 | 19.8063 | 19.8097 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 (90) |
| util rest of house | 0.9963 | 0.9917 | 0.9770 | 0.9276 | 0.8067 | 0.6052 | 0.4103 | 0.4695 | 0.7699 | 0.9597 | 0.9925 | 0.9972 (91) |
| MIT 2 | 18.1663 | 18.3757 | 18.7310 | 19.1752 | 19.5163 | 19.6809 | 19.7178 | 19.7131 | 19.6036 | 19.1440 | 18.5806 | 18.1509 (92) |
| Living area fraction | 18.6899 | 18.8768 | 19.1960 | 19.5964 | 19.9107 | 20.0702 | 20.1108 | 20.1045 | 19.9907 | 19.5661 | 19.0593 | 18.6740 (93) |
| Temperature adjustment | 18.5399 | 18.7268 | 19.0460 | 19.4464 | 19.7607 | 19.9202 | 19.9608 | 19.9545 | 19.8407 | 19.4161 | 18.9093 | -0.1500 (94) |
| adjusted MIT | 18.5399 | 18.7268 | 19.0460 | 19.4464 | 19.7607 | 19.9202 | 19.9608 | 19.9545 | 19.8407 | 19.4161 | 18.9093 | 18.5240 (95) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------|---|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Useful gains | 499.8035 | 591.6656 | 688.5984 | 761.7563 | 728.0670 | 550.2491 | 365.0845 | 382.1409 | 536.5068 | 551.9364 | 491.9887 | 470.5375 (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 | 1592.5166 | 1541.2823 | 1393.9407 | 1164.3189 | 889.8952 | 587.3510 | 371.0258 | 392.4116 | 633.7709 | 973.2930 | 1303.7383 | 1581.3548 (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 (98) |
| Space heating kWh | 812.9785 | 638.1424 | 524.7747 | 289.8450 | 120.4001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 313.4893 | 584.4597 | 826.4481 (98) |
| Space heating | Total per year (kWh/year) = Sum(98)m = 49.5723 (99) | | | | | | | | | | | |
| Space heating per m2 | | | | | | | | | | | | |

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.1000 (201) | |
|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|----------|-----------------|------------------|
| Fraction of space heat from main system(s) | | | | | | | | | | | | 0.9000 (202) | |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 91.9000 (206) | |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 65.0000 (208) | |
| Space heating requirement | | | | | | | | | | | | 4025.5539 (211) | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 812.9785 | 638.1424 | 524.7747 | 289.8450 | 120.4001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 313.4893 | 584.4597 | 826.4481 | (98) |
| Space heating efficiency (main heating system 1) | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.9000 | 91.9000 | 91.9000 | (210) |
| Space heating fuel (main heating system) | 796.1705 | 624.9490 | 513.9251 | 283.8526 | 117.9109 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 307.0080 | 572.3762 | 809.3616 | (211) |
| Water heating requirement | 125.0736 | 98.1758 | 80.7346 | 44.5915 | 18.5231 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 48.2291 | 89.9169 | 127.1459 | (215) |
| Water heating requirement | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 | (64) |
| Efficiency of water heater (217)m | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | (216) |
| Fuel for water heating, kWh/month | 228.1812 | 200.9877 | 209.1147 | 185.4742 | 179.5718 | 158.1568 | 151.5262 | 168.9162 | 170.7817 | 194.4690 | 207.5919 | 222.7779 | (219) |
| Water heating fuel used | | | | | | | | | | | | | (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 4025.5539 (211) |
| Space heating fuel - secondary | | | | | | | | | | | | | 632.3904 (215) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| (MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840) | | | | | | | | | | | | | |
| mechanical ventilation fans (SFP = 0.1840) | | | | | | | | | | | | | 46.6272 (230a) |
| central heating pump | | | | | | | | | | | | | 30.0000 (230c) |
| main heating flue fan | | | | | | | | | | | | | 45.0000 (230e) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 121.6272 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | 367.8206 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 1.50 * 1080 * 1.00) = | | | | | | | | | | -1295.4295 | | | -1295.4295 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | | 6129.5120 (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year |
|---|-----------------|----------------------------|-----------------------|
| Space heating - main system 1 | 4025.5539 | 0.2160 | 869.5196 (261) |
| Space heating - secondary | 632.3904 | 0.0190 | 12.0154 (263) |
| Water heating (other fuel) | 2277.5494 | 0.2160 | 491.9507 (264) |
| Space and water heating | | | 1373.4857 (265) |
| Pumps and fans | 121.6272 | 0.5190 | 63.1245 (267) |
| Energy for lighting | 367.8206 | 0.5190 | 190.8989 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1295.4295 | 0.5190 | -672.3279 (269) |
| Total CO2, kg/year | | | 955.1812 (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 11.5200 (273) |

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

| | | | |
|---|--|-----|-------------|
| DER | | | 11.5200 ZC1 |
| Total Floor Area | | TFA | 82.9200 |
| Assumed number of occupants | | N | 2.5159 |
| CO2 emission factor in Table 12 for electricity displaced from grid | | EF | 0.5190 |
| CO2 emissions from appliances, equation (L14) | | | 16.1105 ZC2 |
| CO2 emissions from cooking, equation (L16) | | | 2.1633 ZC3 |
| Total CO2 emissions | | | 29.7938 ZC4 |
| Residual CO2 emissions offset from biofuel CHP | | | 0.0000 ZC5 |
| Additional allowable electricity generation, kWh/m ² /year | | | 0.0000 ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | | | 0.0000 ZC7 |
| Net CO2 emissions | | | 29.7938 ZC8 |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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 | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-------|---|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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) = 0.1444 (8) |
| Pressure test | | | | | Yes |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.3944 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | | (21) = (18) x (20) = 0.3353 (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 | 0.4275 | 0.4191 | 0.4107 | 0.3688 | 0.3604 | 0.3185 | 0.3185 | 0.3101 | 0.3353 | 0.3604 | 0.3772 | 0.3939 (22b) |
| Effective ac | 0.5914 | 0.5878 | 0.5843 | 0.5680 | 0.5649 | 0.5507 | 0.5507 | 0.5481 | 0.5562 | 0.5649 | 0.5711 | 0.5776 (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 Semi-glazed door | | | 2.1200 | 1.2000 | 2.5440 | | (26a) |
| TER Opening Type (Uw = 1.40) | | | 12.8200 | 1.3258 | 16.9962 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1300 | 1.0725 | | (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1300 | 4.0495 | | (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | | (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1800 | 2.4804 | | (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 48.3044 | | (33) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.4717 (36)
 Total fabric heat loss (33) + (36) = 62.7761 (37)

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

| (38)m | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Heat transfer coeff | 40.5349 | 40.2918 | 40.0534 | 38.9338 | 38.7243 | 37.7492 | 37.7492 | 37.5686 | 38.1248 | 38.7243 | 39.1481 | 39.5911 (38) |
| Average = Sum(39)m / 12 = | 103.3111 | 103.0679 | 102.8295 | 101.7099 | 101.5005 | 100.5253 | 100.5253 | 100.3448 | 100.9009 | 101.5005 | 101.9242 | 102.3672 (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------|-------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP | 1.2459 | 1.2430 | 1.2401 | 1.2266 | 1.2241 | 1.2123 | 1.2123 | 1.2101 | 1.2168 | 1.2241 | 1.2292 | 1.2345 (40) |
| HLP (average) | 1.2266 (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 2.5159 (42)
 Average daily hot water use (litres/day) 93.9534 (43)

| Daily hot water use | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--|-----------------------------------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|---------------|
| Energy conte | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |
| Energy content (annual) | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (45) |
| Distribution loss (46)m = 0.15 x (45)m | Total = Sum(45)m = 1478.2535 (45) | | | | | | | | | | | |
| Water storage loss: | 22.9895 | 20.1068 | 20.7484 | 18.0889 | 17.3568 | 14.9776 | 13.8789 | 15.9263 | 16.1165 | 18.7822 | 20.5022 | 22.2641 (46) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | 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 | 0.0000 | 0.0000 | (57) |
| Combi loss | 50.9589 | 45.8390 | 48.8352 | 45.4065 | 45.0050 | 41.6999 | 43.0899 | 45.0050 | 45.4065 | 48.8352 | 49.1132 | 50.9589 | 50.9589 | 50.9589 | (61) |
| Total heat required for water heating calculated for each month | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 | 199.3862 | 199.3862 | (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 | 0.0000 | 0.0000 | (63) |
| Output from w/h | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 | 199.3862 | 199.3862 | (64) |
| Heat gains from water heating, kWh/month | 63.6998 | 56.0297 | 58.2010 | 51.4488 | 49.7254 | 43.6252 | 41.5374 | 46.5545 | 47.0765 | 53.8427 | 57.7249 | 62.0918 | 62.0918 | 62.0918 | (65) |

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

| | | | | | | | | | | | | | |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| (66)m | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 21.1125 | 18.7519 | 15.2501 | 11.5453 | 8.6303 | 7.2860 | 7.8728 | 10.2334 | 13.7352 | 17.4400 | 20.3551 | 21.6993 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 225.4349 | 227.7742 | 221.8792 | 209.3295 | 193.4877 | 178.5987 | 168.6519 | 166.3126 | 172.2076 | 184.7573 | 200.5991 | 215.4881 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | (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) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | (71) |
| Water heating gains (Table 5) | 85.6180 | 83.3776 | 78.2272 | 71.4566 | 66.8352 | 60.5906 | 55.8298 | 62.5732 | 65.3840 | 72.3692 | 80.1735 | 83.4567 | (72) |
| Total internal gains | 395.9044 | 393.6427 | 379.0955 | 356.0704 | 332.6922 | 310.2144 | 296.0936 | 302.8582 | 315.0658 | 338.3055 | 364.8666 | 384.3831 | (73) |

6. Solar gains

| | | | | | | | | | | | | | |
|-------------|------------------------|--|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|----------|----------|----------|------|
| [Jan] | Area m ² | Solar flux Table 6a W/m ² | Specific data or Table 6b g | Specific data or Table 6c FF | Access factor Table 6d | Gains W | | | | | | | |
| East | 8.2700 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 49.6392 (76) | | | | | | | |
| South | 0.6800 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 9.7159 (78) | | | | | | | |
| West | 3.8700 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 23.2290 (80) | | | | | | | |
| Solar gains | 82.5840 | 158.4577 | 255.0215 | 365.2808 | 443.4621 | 452.4987 | 431.3720 | 373.0597 | 294.2002 | 186.3050 | 102.3746 | 68.3186 | (83) |
| Total gains | 478.4884 | 552.1004 | 634.1170 | 721.3512 | 776.1543 | 762.7131 | 727.4656 | 675.9178 | 609.2660 | 524.6105 | 467.2413 | 452.7018 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, T _{hl} (C) | | | | | | | | | | | | | 21.0000 (85) |
| Utilisation factor for gains for living area, n _{il,m} (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 55.7378 | 55.8693 | 55.9988 | 56.6153 | 56.7321 | 57.2824 | 57.2824 | 57.3855 | 57.0692 | 56.7321 | 56.4962 | 56.2517 | |
| alpha | 4.7159 | 4.7246 | 4.7333 | 4.7744 | 4.7821 | 4.8188 | 4.8188 | 4.8257 | 4.8046 | 4.7821 | 4.7664 | 4.7501 | |
| util living area | 0.9983 | 0.9963 | 0.9899 | 0.9662 | 0.8971 | 0.7510 | 0.5851 | 0.6444 | 0.8779 | 0.9819 | 0.9966 | 0.9987 | (86) |
| MIT | 19.6112 | 19.7645 | 20.0380 | 20.4038 | 20.7232 | 20.9210 | 20.9813 | 20.9708 | 20.8195 | 20.3960 | 19.9381 | 19.5860 | (87) |
| Th 2 | 19.8834 | 19.8858 | 19.8880 | 19.8988 | 19.9008 | 19.9102 | 19.9102 | 19.9119 | 19.9065 | 19.9008 | 19.8967 | 19.8925 | (88) |
| util rest of house | 0.9977 | 0.9950 | 0.9861 | 0.9525 | 0.8547 | 0.6569 | 0.4516 | 0.5103 | 0.8111 | 0.9723 | 0.9952 | 0.9982 | (89) |
| MIT 2 | 18.0369 | 18.2623 | 18.6617 | 19.1927 | 19.6241 | 19.8563 | 19.9033 | 19.8997 | 19.7563 | 19.1905 | 18.5242 | 18.0064 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3268 | (91) |
| MIT | 18.5514 | 18.7533 | 19.1115 | 19.5885 | 19.9833 | 20.2043 | 20.2556 | 20.2497 | 20.1038 | 19.5845 | 18.9863 | 18.5226 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.5514 | 18.7533 | 19.1115 | 19.5885 | 19.9833 | 20.2043 | 20.2556 | 20.2497 | 20.1038 | 19.5845 | 18.9863 | 18.5226 | (93) |

8. Space heating requirement

| | | | | | | | | | | | | | |
|----------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Useful gains | 476.8743 | 548.2814 | 622.9698 | 683.5676 | 666.2318 | 522.0888 | 360.5799 | 374.7305 | 502.8535 | 508.0998 | 464.1689 | 451.5225 | (94) |
| 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 | 1472.3309 | 1427.8275 | 1296.8346 | 1087.1259 | 840.7603 | 563.3731 | 367.4789 | 386.3018 | 605.7848 | 911.9294 | 1211.5017 | 1466.1677 | (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 | 740.6197 | 591.0550 | 501.3554 | 290.5620 | 129.8492 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 300.4492 | 538.0796 | 754.8961 | (98) |
| Space heating | | | | | | | | | | | | 3846.8662 | (98) |
| Space heating per m ² | | | | | | | | | | | | 46.3925 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 93.4000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 4118.7004 (211) |
| Space heating requirement | 740.6197 | 591.0550 | 501.3554 | 290.5620 | 129.8492 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 300.4492 | 538.0796 | 754.8961 | (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) | 792.9547 | 632.8212 | 536.7831 | 311.0942 | 139.0248 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 321.6801 | 576.1023 | 808.2399 | (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 requirement | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 | (64) |
| Efficiency of water heater (217)m | 88.0074 | 87.8226 | 87.4114 | 86.4467 | 84.5199 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 86.4132 | 87.5729 | 88.0851 | (216) |
| Fuel for water heating, kWh/month | 232.0511 | 204.8266 | 214.1113 | 192.0252 | 190.1524 | 176.2769 | 168.8867 | 188.2690 | 190.3483 | 201.4157 | 212.1601 | 226.3562 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 2396.8796 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 4118.7004 (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) | | | | | | | | | | | | | 372.8536 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 6963.4336 (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year |
|---|-----------------|----------------------------|-----------------------|
| Space heating - main system 1 | 4118.7004 | 0.2160 | 889.6393 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 2396.8796 | 0.2160 | 517.7260 (264) |
| Space and water heating | | | 1407.3653 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 372.8536 | 0.5190 | 193.5110 (268) |
| Total CO2, kg/m2/year | | | 1639.8013 (272) |
| Emissions per m2 for space and water heating | | | 16.9726 (272a) |
| Fuel factor (mains gas) | | | 1.0000 |
| Emissions per m2 for lighting | | | 2.3337 (272b) |
| Emissions per m2 for pumps and fans | | | 0.4694 (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (16.9726 * 1.00) + 2.3337 + 0.4694, rounded to 2 d.p. | | | 19.7800 (273) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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 | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-----------------------------|--|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | | | | | Air changes per hour 30.0000 / (5) = 0.1444 (8) |
| Pressure test | | | | | Yes |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.3944 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | (21) = (18) x (20) = | 0.3353 (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 | 0.4275 | 0.4191 | 0.4107 | 0.3688 | 0.3604 | 0.3185 | 0.3185 | 0.3101 | 0.3353 | 0.3604 | 0.3772 | 0.3939 (22b) |
| Effective ac | 0.5914 | 0.5878 | 0.5843 | 0.5680 | 0.5649 | 0.5507 | 0.5507 | 0.5481 | 0.5562 | 0.5649 | 0.5711 | 0.5776 (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 | 1.8000 | 3.8160 | | (26a) |
| Opening Type 2 (Uw = 1.60) | | | 12.8200 | 1.5038 | 19.2782 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1400 | 1.1550 | 75.0000 | 618.7500 (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1838 | 5.7241 | 20.0000 | 623.0000 (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | 110.0000 | 9802.1000 (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1524 | 2.0999 | 110.0000 | 1515.8000 (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | 9.0000 | 354.6000 (30) |
| Total net area of external elements Aum(A, m2) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 53.2350 | | (33) |
| Party Wall 1 | | | 65.8300 | 0.0000 | 0.0000 | 70.0000 | 4608.1000 (32) |
| Internal Wall 2 | | | 76.5100 | | | 9.0000 | 688.5900 (32c) |
| Internal Floor 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32d) |
| Internal Ceiling 1 | | | 39.3800 | | | 9.0000 | 354.4200 (32e) |
| Heat capacity Cm = Sum(A x k) | | | | | | (28)...(30) + (32) + (32a)...(32e) = | 19274.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 232.4433 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 22.8919 (36) |
| Total fabric heat loss | | | | | | (33) + (36) = | 76.1269 (37) |

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

| (38)m | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Heat transfer coeff | 40.5349 | 40.2918 | 40.0534 | 38.9338 | 38.7243 | 37.7492 | 37.7492 | 37.5686 | 38.1248 | 38.7243 | 39.1481 | 39.5911 (38) |
| Average = Sum(39)m / 12 = | 116.6618 | 116.4186 | 116.1803 | 115.0607 | 114.8512 | 113.8761 | 113.8761 | 113.6955 | 114.2517 | 114.8512 | 115.2750 | 115.7180 (39) |
| HLP | 1.4069 | 1.4040 | 1.4011 | 1.3876 | 1.3851 | 1.3733 | 1.3733 | 1.3711 | 1.3779 | 1.3851 | 1.3902 | 1.3955 (40) |
| HLP (average) | | | | | | | | | | | | 1.3876 (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 (41) |

4. Water heating energy requirements (kWh/year)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--|----------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------|
| Assumed occupancy | | | | | | | | | | | | 2.5159 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 93.9534 (43) |
| Daily hot water use | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | |
|--|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|---------------|
| Energy content (annual) | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (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 | | | | | | | | | | | | |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (57) |
| Heat gains from water heating, kWh/month | 32.5684 | 28.4846 | 29.3935 | 25.6260 | 24.5887 | 21.2182 | 19.6618 | 22.5622 | 22.8317 | 26.6081 | 29.0448 | 31.5408 (65) |

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

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| (66)m | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 20.8275 | 18.4988 | 15.0443 | 11.3895 | 8.5138 | 7.1877 | 7.7665 | 10.0952 | 13.5498 | 17.2046 | 20.0803 | 21.4064 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 225.4349 | 227.7742 | 221.8792 | 209.3295 | 193.4877 | 178.5987 | 168.6519 | 166.3126 | 172.2076 | 184.7573 | 200.5991 | 215.4881 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 (71) |
| Water heating gains (Table 5) | 43.7748 | 42.3878 | 39.5074 | 35.5916 | 33.0494 | 29.4697 | 26.4271 | 30.3255 | 31.7106 | 35.7636 | 40.3400 | 42.3935 (72) |
| Total internal gains | 350.7762 | 349.3998 | 337.1699 | 317.0496 | 295.7899 | 275.9951 | 263.5846 | 267.4724 | 278.2071 | 298.4645 | 321.7584 | 340.0271 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | Specific data or Table 6b g | Specific data or Table 6c FF | Access factor Table 6d | Gains W | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| East | 8.2700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 64.1595 (76) | | | | | | |
| South | 0.6800 | 46.7521 | 0.7600 | 0.7500 | 0.7700 | 12.5579 (78) | | | | | | |
| West | 3.8700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 30.0238 (80) | | | | | | |
| Solar gains | 106.7413 | 204.8092 | 329.6196 | 472.1316 | 573.1823 | 584.8623 | 557.5557 | 482.1860 | 380.2587 | 240.8024 | 132.3210 | 88.3030 (83) |
| Total gains | 457.5175 | 554.2090 | 666.7895 | 789.1812 | 868.9722 | 860.8574 | 821.1403 | 749.6584 | 658.4658 | 539.2669 | 454.0794 | 428.3300 (84) |

7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Thl (C) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | 21.0000 (85) |
| tau | 45.8929 | 45.9887 | 46.0831 | 46.5315 | 46.6164 | 47.0155 | 47.0155 | 47.0902 | 46.8610 | 46.6164 | 46.4450 | 46.2672 |
| alpha | 4.0595 | 4.0659 | 4.0722 | 4.1021 | 4.1078 | 4.1344 | 4.1344 | 4.1393 | 4.1241 | 4.1078 | 4.0963 | 4.0845 |
| util living area | 0.9979 | 0.9950 | 0.9860 | 0.9553 | 0.8774 | 0.7331 | 0.5767 | 0.6413 | 0.8698 | 0.9787 | 0.9959 | 0.9984 (86) |
| MIT | 19.2956 | 19.4877 | 19.8251 | 20.2681 | 20.6493 | 20.8877 | 20.9684 | 20.9514 | 20.7524 | 20.2352 | 19.6819 | 19.2637 (87) |
| Th 2 | 19.7580 | 19.7603 | 19.7625 | 19.7728 | 19.7748 | 19.7838 | 19.7838 | 19.7855 | 19.7804 | 19.7748 | 19.7709 | 19.7668 (88) |
| util rest of house | | | | | | | | | | | | |
| MIT 2 | 0.9971 | 0.9933 | 0.9810 | 0.9384 | 0.8295 | 0.6328 | 0.4330 | 0.4971 | 0.7990 | 0.9678 | 0.9942 | 0.9978 (89) |
| Living area fraction | 18.2188 | 18.4119 | 18.7483 | 19.1875 | 19.5378 | 19.7315 | 19.7758 | 19.7714 | 19.6392 | 19.1647 | 18.6143 | 18.1936 (90) |
| Temperature adjustment | 18.5707 | 18.7635 | 19.1002 | 19.5406 | 19.9010 | 20.1093 | 20.1656 | 20.1571 | 20.0030 | 19.5146 | 18.9632 | 18.5434 (92) |
| adjusted MIT | 18.5707 | 18.7635 | 19.1002 | 19.5406 | 19.9010 | 20.1093 | 20.1656 | 20.1571 | 20.0030 | 19.5146 | 18.9632 | 18.5434 (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|---------------------------|
| Useful gains | 455.7627 | 549.4727 | 651.7452 | 737.3703 | 725.7704 | 570.0905 | 394.5598 | 408.1960 | 536.2272 | 520.2143 | 450.7519 | 427.0717 (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 | 1664.8492 | 1613.9673 | 1463.8952 | 1224.3195 | 941.8993 | 627.3811 | 406.0311 | 427.1605 | 674.4266 | 1023.8468 | 1367.5264 | 1659.7848 (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 (97a) |
| Space heating kWh | 899.5604 | 715.3404 | 604.2396 | 350.6034 | 160.7999 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 374.7026 | 660.0776 | 917.1385 (98) |
| Space heating per m2 | | | | | | | | | | | | 4682.4625 (98) |
| | | | | | | | | | | | | (98) / (4) = 56.4696 (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 | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | | |
|--|--------|--------|--------|--------|--------|-----------|-----------|----------|--------|--------|--------|--------------------------|--------|-------|
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1070.4351 | 842.6829 | 864.0857 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) | |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.8162 | 0.8831 | 0.8491 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) | |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 873.7278 | 744.1751 | 733.6897 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) | |
| Month fracti | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1100.5396 | 1052.1814 | 970.3156 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) | |
| Space cooling kWh | 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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 163.3045 | 229.1567 | 176.0497 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) | |
| Cooled fraction | | | | | | | | | | | | 568.5109 | (104) | |
| Intermittency factor (Table 10b) | | | | | | | | | | | | FC = cooled area / (4) = | 1.0000 | (105) |
| Space cooling kWh | 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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 40.8261 | 57.2892 | 44.0124 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) | |
| Space cooling per m2 | | | | | | | | | | | | 142.1277 | (107) | |
| Energy for space heating | | | | | | | | | | | | 1.7140 | (108) | |
| Energy for space cooling | | | | | | | | | | | | 56.4696 | (99) | |
| Total | | | | | | | | | | | | 1.7140 | (108) | |
| Dwelling Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 58.1837 | (109) | |
| | | | | | | | | | | | | 58.2 | (109) | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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 | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|--------|--------|---|--------|--------|--------|--------|--------|--------|--------------|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) | | | | | | | |
| Number of open flues | 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) = 0.1444 (8) | | | | | | | |
| Pressure test | | | | | Yes | | | | | | | |
| Measured/design AP50 | | | | | 5.0000 | | | | | | | |
| Infiltration rate | | | | | 0.3944 (18) | | | | | | | |
| Number of sides sheltered | | | | | 2 (19) | | | | | | | |
| Shelter factor | | | | | (20) = 1 - [0.075 x (19)] = 0.8500 (20) | | | | | | | |
| Infiltration rate adjusted to include shelter factor | | | | | (21) = (18) x (20) = 0.3353 (21) | | | | | | | |
| Wind speed | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Wind factor | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Adj infilt rate | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Effective ac | 0.4275 | 0.4191 | 0.4107 | 0.3688 | 0.3604 | 0.3185 | 0.3185 | 0.3101 | 0.3353 | 0.3604 | 0.3772 | 0.3939 (22b) |
| | 0.5914 | 0.5878 | 0.5843 | 0.5680 | 0.5649 | 0.5507 | 0.5507 | 0.5481 | 0.5562 | 0.5649 | 0.5711 | 0.5776 (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 Semi-glazed door | | | 2.1200 | 1.2000 | 2.5440 | | (26a) | | | | | |
| TER Opening Type (Uw = 1.40) | | | 12.8200 | 1.3258 | 16.9962 | | (27) | | | | | |
| Heat Loss Floor 1 | | | 8.2500 | 0.1300 | 1.0725 | | (28a) | | | | | |
| Heat Loss Floor 2 | | | 31.1500 | 0.1300 | 4.0495 | | (28b) | | | | | |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | | (29a) | | | | | |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1800 | 2.4804 | | (29a) | | | | | |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | | | 196.6300 | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = 48.3044 | | (33) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 250.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 14.4717 (36) | | | | | |
| Total fabric heat loss | | | | | | | (33) + (36) = 62.7761 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Heat transfer coeff | 40.5349 | 40.2918 | 40.0534 | 38.9338 | 38.7243 | 37.7492 | 37.7492 | 37.5686 | 38.1248 | 38.7243 | 39.1481 | 39.5911 (38) |
| Average = Sum(39)m / 12 = | 103.3111 | 103.0679 | 102.8295 | 101.7099 | 101.5005 | 100.5253 | 100.5253 | 100.3448 | 100.9009 | 101.5005 | 101.9242 | 102.3672 (39) |
| | 101.7089 (39) | | | | | | | | | | | |
| HLP | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| HLP (average) | 1.2459 | 1.2430 | 1.2401 | 1.2266 | 1.2241 | 1.2123 | 1.2123 | 1.2101 | 1.2168 | 1.2241 | 1.2292 | 1.2345 (40) |
| Days in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 (41) |

4. Water heating energy requirements (kWh/year)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--|-----------------------------------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|---------------|
| Assumed occupancy | | | | | | | | | | | | |
| Average daily hot water use (litres/day) | 2.5159 (42) | | | | | | | | | | | |
| Daily hot water use | 93.9534 (43) | | | | | | | | | | | |
| Energy conte | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |
| Energy content (annual) | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (45) |
| Distribution loss (46)m = 0.15 x (45)m | Total = Sum(45)m = 1478.2535 (45) | | | | | | | | | | | |
| Water 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 (46) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| 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) |
| Heat gains from water heating, kWh/month | 32.5684 | 28.4846 | 29.3935 | 25.6260 | 24.5887 | 21.2182 | 19.6618 | 22.5622 | 22.8317 | 26.6081 | 29.0448 | 31.5408 | (65) |

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

| | | | | | | | | | | | | | |
|---|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| (66)m | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | 125.7967 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 21.1125 | 18.7519 | 15.2501 | 11.5453 | 8.6303 | 7.2860 | 7.8728 | 10.2334 | 13.7352 | 17.4400 | 20.3551 | 21.6993 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 225.4349 | 227.7742 | 221.8792 | 209.3295 | 193.4877 | 178.5987 | 168.6519 | 166.3126 | 172.2076 | 184.7573 | 200.5991 | 215.4881 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | 35.5797 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | (71) |
| Water heating gains (Table 5) | 43.7748 | 42.3878 | 39.5074 | 35.5916 | 33.0494 | 29.4697 | 26.4271 | 30.3255 | 31.7106 | 35.7636 | 40.3400 | 42.3935 | (72) |
| Total internal gains | 351.0612 | 349.6529 | 337.3758 | 317.2055 | 295.9064 | 276.0935 | 263.6909 | 267.6105 | 278.3925 | 298.6999 | 322.0332 | 340.3200 | (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 | |
| East | 8.2700 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 49.6392 (76) |
| South | 0.6800 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 9.7159 (78) |
| West | 3.8700 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 23.2290 (80) |

| | | | | | | | | | | | | | |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Solar gains | 82.5840 | 158.4577 | 255.0215 | 365.2808 | 443.4621 | 452.4987 | 431.3720 | 373.0597 | 294.2002 | 186.3050 | 102.3746 | 68.3186 | (83) |
| Total gains | 433.6452 | 508.1106 | 592.3972 | 682.4862 | 739.3685 | 728.5922 | 695.0629 | 640.6702 | 572.5926 | 485.0049 | 424.4078 | 408.6386 | (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 | 55.7378 | 55.8693 | 55.9988 | 56.6153 | 56.7321 | 57.2824 | 57.2824 | 57.3855 | 57.0692 | 56.7321 | 56.4962 | 56.2517 | |
| alpha | 4.7159 | 4.7246 | 4.7333 | 4.7744 | 4.7821 | 4.8188 | 4.8188 | 4.8257 | 4.8046 | 4.7821 | 4.7664 | 4.7501 | |
| util living area | 0.9989 | 0.9974 | 0.9923 | 0.9724 | 0.9109 | 0.7729 | 0.6081 | 0.6719 | 0.8977 | 0.9867 | 0.9978 | 0.9992 | (86) |
| MIT | 19.5616 | 19.7163 | 19.9936 | 20.3666 | 20.6978 | 20.9102 | 20.9780 | 20.9651 | 20.7961 | 20.3552 | 19.8910 | 19.5371 | (87) |
| Th 2 | 19.8834 | 19.8858 | 19.8880 | 19.8988 | 19.9008 | 19.9102 | 19.9102 | 19.9119 | 19.9065 | 19.9008 | 19.8967 | 19.8925 | (88) |
| util rest of house | 0.9985 | 0.9965 | 0.9894 | 0.9609 | 0.8722 | 0.6803 | 0.4715 | 0.5358 | 0.8371 | 0.9794 | 0.9968 | 0.9989 | (89) |
| MIT 2 | 18.5733 | 18.7294 | 19.0071 | 19.3817 | 19.6912 | 19.8675 | 19.9045 | 19.9017 | 19.7873 | 19.3767 | 18.9128 | 18.5559 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.3268 | (91) |
| MIT | 18.8963 | 19.0520 | 19.3295 | 19.7036 | 20.0202 | 20.2083 | 20.2553 | 20.2492 | 20.1170 | 19.6965 | 19.2325 | 18.8766 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.8963 | 19.0520 | 19.3295 | 19.7036 | 20.0202 | 20.2083 | 20.2553 | 20.2492 | 20.1170 | 19.6965 | 19.2325 | 18.8766 | (93) |

8. Space heating requirement

| | | | | | | | | | | | | | |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|-----------|-------|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Useful gains | 432.7788 | 505.8343 | 584.9440 | 654.0555 | 648.5046 | 515.9616 | 359.2256 | 372.1674 | 487.2908 | 474.1473 | 422.7002 | 408.0251 | (94) |
| 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 | 1507.9610 | 1458.6134 | 1319.2509 | 1098.8338 | 844.5015 | 563.7713 | 367.4549 | 386.2489 | 607.1202 | 923.2942 | 1236.5948 | 1502.4049 | (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 | 799.9356 | 640.2675 | 546.3243 | 320.2404 | 145.8217 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 334.1653 | 586.0041 | 814.2186 | (98) |
| Space heating | | | | | | | | | | | | 4186.9776 | (98) |
| Space heating per m2 | | | | | | | | | | (98) / (4) = | | 50.4942 | (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 | 944.9381 | 743.8875 | 762.6201 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.8286 | 0.8983 | 0.8671 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 783.0149 | 668.2068 | 661.2678 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 946.0749 | 904.9597 | 843.1107 | 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) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | |
|--|--------|--------|--------|--------|--------|----------|----------|----------|--------------------------|--------|--------|--------|----------------|
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 117.4031 | 176.1442 | 135.2911 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Space cooling | | | | | | | | | | | | | 428.8385 (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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 29.3508 | 44.0361 | 33.8228 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling | | | | | | | | | | | | | 107.2096 (107) |
| Space cooling per m2 | | | | | | | | | | | | | 1.2929 (108) |
| Energy for space heating | | | | | | | | | | | | | 50.4942 (99) |
| Energy for space cooling | | | | | | | | | | | | | 1.2929 (108) |
| Total | | | | | | | | | | | | | 51.7871 (109) |
| Target Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | | 59.6 (109) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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 | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-----------------------------|---------------------------|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.2500 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | (21) = (18) x (20) = | 0.2125 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.0000 | 5.0000 | 4.9000 | 4.3000 | 4.2000 | 3.9000 | 3.7000 | 3.5000 | 3.9000 | 4.2000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2500 | 1.2500 | 1.2250 | 1.0750 | 1.0500 | 0.9750 | 0.9250 | 0.8750 | 0.9750 | 1.0500 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.2656 | 0.2656 | 0.2603 | 0.2284 | 0.2231 | 0.2072 | 0.1966 | 0.1859 | 0.2072 | 0.2231 | 0.2391 | 0.2497 (22b) |
| Mechanical extract ventilation - decentralised | | | | | | | | | | | | 0.5000 (23a) |
| If mechanical ventilation: | | | | | | | | | | | | 0.5000 (23a) |
| Effective ac | 0.5156 | 0.5156 | 0.5103 | 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 | 1.8000 | 3.8160 | | (26a) |
| Opening Type 2 (Uw = 1.60) | | | 12.8200 | 1.5038 | 19.2782 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1400 | 1.1550 | 75.0000 | 618.7500 (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1838 | 5.7241 | 20.0000 | 623.0000 (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | 110.0000 | 9802.1000 (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1524 | 2.0999 | 110.0000 | 1515.8000 (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | 9.0000 | 354.6000 (30) |
| Total net area of external elements Aum(A, m2) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 53.2350 | | (33) |
| Party Wall 1 | | | 65.8300 | 0.0000 | 0.0000 | 70.0000 | 4608.1000 (32) |
| Internal Wall 2 | | | 76.5100 | | | 9.0000 | 688.5900 (32c) |
| Internal Floor 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32d) |
| Internal Ceiling 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32e) |
| Heat capacity Cm = Sum(A x k) | | | | | | (28)...(30) + (32) + (32a)...(32e) = | 19628.6200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 236.7176 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 22.8919 (36) |
| Total fabric heat loss | | | | | | (33) + (36) = | 76.1269 (37) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | 35.3435 | 35.3435 | 34.9793 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 (38) |
| Heat transfer coeff | 111.4703 | 111.4703 | 111.1062 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 110.6367 (39) |
| HLP | 1.3443 | 1.3443 | 1.3399 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 (40) |
| HLP (average) | | | | | | | | | | | | 1.3343 (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 | 2.5159 (42) |
| Average daily hot water use (litres/day) | 93.9534 (43) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |
| Energy conte | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (45) |
| Energy content (annual) | Total = Sum(45)m = 1478.2535 (45) | | | | | | | | | | | |
| Distribution loss (46)m = 0.15 x (45)m | 22.9895 | 20.1068 | 20.7484 | 18.0889 | 17.3568 | 14.9776 | 13.8789 | 15.9263 | 16.1165 | 18.7822 | 20.5022 | 22.2641 (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 | 50.9589 | 45.8390 | 48.8352 | 45.4065 | 45.0050 | 41.6999 | 43.0899 | 45.0050 | 45.4065 | 48.8352 | 49.1132 | 50.9589 (61) |
| Total heat required for water heating calculated for each month | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (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) |
| Output from w/h | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (64) |
| RHI water heating demand | Total per year (kWh/year) = Sum(64)m = 2038.4067 (64) | | | | | | | | | | | |
| Heat gains from water heating, kWh/month | 63.6998 | 56.0297 | 58.2010 | 51.4488 | 49.7254 | 43.6252 | 41.5374 | 46.5545 | 47.0765 | 53.8427 | 57.7249 | 62.0918 (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 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 52.0688 | 46.2471 | 37.6106 | 28.4737 | 21.2844 | 17.9692 | 19.4163 | 25.2381 | 33.8745 | 43.0115 | 50.2008 | 53.5160 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 336.4700 | 339.9615 | 331.1630 | 312.4321 | 288.7876 | 266.5652 | 251.7193 | 248.2278 | 257.0262 | 275.7572 | 299.4016 | 321.6240 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 (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) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 (71) |
| Water heating gains (Table 5) | 85.6180 | 83.3776 | 78.2272 | 71.4566 | 66.8352 | 60.5906 | 55.8298 | 62.5732 | 65.3840 | 72.3692 | 80.1735 | 83.4567 (72) |
| Total internal gains | 580.0870 | 575.5163 | 552.9310 | 518.2926 | 482.8375 | 451.0552 | 432.8957 | 441.9693 | 462.2150 | 497.0680 | 535.7061 | 564.5269 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| East | 8.2700 | 18.2144 | 0.7600 | 0.7500 | 0.7700 | 59.5015 (76) | | | | | | |
| South | 0.6900 | 43.9264 | 0.7600 | 0.7500 | 0.7700 | 11.7989 (78) | | | | | | |
| West | 3.8700 | 18.2144 | 0.7600 | 0.7500 | 0.7700 | 27.8441 (80) | | | | | | |
| Solar gains | 99.1445 | 190.7455 | 320.9305 | 464.5394 | 559.9997 | 565.9194 | 538.4572 | 459.2736 | 365.4138 | 223.8003 | 116.9955 | 80.3978 (83) |
| Total gains | 679.2315 | 766.2618 | 873.8615 | 982.8320 | 1042.8372 | 1016.9747 | 971.3529 | 901.2428 | 827.6288 | 720.8683 | 652.7015 | 644.9248 (84) |

7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) | 48.9134 | 48.9134 | 49.0737 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 (85) |
| util living area | 0.9925 | 0.9873 | 0.9721 | 0.9314 | 0.8444 | 0.7198 | 0.6170 | 0.6704 | 0.8455 | 0.9599 | 0.9879 | 0.9940 (86) |
| MIT | 19.8544 | 19.9630 | 20.1898 | 20.4725 | 20.7170 | 20.8546 | 20.9018 | 20.8870 | 20.7608 | 20.4418 | 20.0986 | 19.8304 (87) |
| Th 2 | 19.8063 | 19.8063 | 19.8097 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 (88) |
| util rest of house | 0.9903 | 0.9835 | 0.9635 | 0.9101 | 0.7964 | 0.6363 | 0.5085 | 0.5632 | 0.7833 | 0.9434 | 0.9836 | 0.9922 (89) |
| MIT 2 | 18.2931 | 18.4504 | 18.7794 | 19.1815 | 19.5030 | 19.6609 | 19.7042 | 19.6937 | 19.5653 | 19.1479 | 18.6566 | 18.2658 (90) |
| Living area fraction | fLA = Living area / (4) = | | | | | | | | | | | |
| MIT | 18.8034 | 18.9447 | 19.2403 | 19.6034 | 19.8998 | 20.0510 | 20.0956 | 20.0837 | 19.9560 | 19.5708 | 19.1279 | 18.7772 (92) |
| Temperature adjustment | -0.1500 | | | | | | | | | | | |
| adjusted MIT | 18.6534 | 18.7947 | 19.0903 | 19.4534 | 19.7498 | 19.9010 | 19.9456 | 19.9337 | 19.8060 | 19.4208 | 18.9779 | 18.6272 (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------|----------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|----------------|
| Utilisation | 0.9873 | 0.9792 | 0.9569 | 0.9022 | 0.7933 | 0.6429 | 0.5211 | 0.5748 | 0.7826 | 0.9363 | 0.9794 | 0.9896 (94) |
| Useful gains | 670.5846 | 750.3254 | 836.1559 | 886.6715 | 827.2609 | 653.7728 | 506.1853 | 518.0073 | 647.7290 | 674.9325 | 639.2861 | 638.2159 (95) |
| Ext temp. | 3.6000 | 4.0000 | 5.5000 | 7.8000 | 10.7000 | 13.5000 | 15.2000 | 15.0000 | 12.8000 | 9.5000 | 6.3000 | 3.5000 (96) |
| Heat loss rate W | 1678.0027 | 1649.1736 | 1509.9683 | 1286.5270 | 999.0911 | 706.6703 | 523.9098 | 544.6734 | 773.4599 | 1095.2492 | 1399.6289 | 1670.0294 (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 | 749.5191 | 604.0260 | 501.3164 | 287.8960 | 127.8417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 312.7157 | 547.4468 | 767.6692 (98) |
| Space heating | 3898.4308 (98) | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

RHI space heating demand

3898 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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 | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-------|---|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.2500 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | | (21) = (18) x (20) = 0.2125 (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 | 0.2709 | 0.2656 | 0.2603 | 0.2338 | 0.2284 | 0.2019 | 0.2019 | 0.1966 | 0.2125 | 0.2284 | 0.2391 | 0.2497 (22b) |
| Mechanical extract ventilation - decentralised | | | | | | | | | | | | 0.5000 (23a) |
| If mechanical ventilation: | | | | | | | | | | | | 0.5000 (23a) |
| Effective ac | 0.5209 | 0.5156 | 0.5103 | 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 | 1.8000 | 3.8160 | | (26a) |
| Opening Type 2 (Uw = 1.60) | | | 12.8200 | 1.5038 | 19.2782 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1400 | 1.1550 | 75.0000 | 618.7500 (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1838 | 5.7241 | 20.0000 | 623.0000 (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | 110.0000 | 9802.1000 (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1524 | 2.0999 | 110.0000 | 1515.8000 (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | 9.0000 | 354.6000 (30) |
| Total net area of external elements Aum(A, m2) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | 53.2350 | | | (33) |
| Party Wall 1 | | | 65.8300 | 0.0000 | 0.0000 | 70.0000 | 4608.1000 (32) |
| Internal Wall 2 | | | 76.5100 | | | 9.0000 | 688.5900 (32c) |
| Internal Floor 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32d) |
| Internal Ceiling 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32e) |
| Heat capacity Cm = Sum(A x k) | | | (28)...(30) + (32) + (32a)...(32e) = | 19628.6200 (34) | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 236.7176 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 22.8919 (36) |
| Total fabric heat loss | | | (33) + (36) = | 76.1269 (37) | | | |

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

| (38)m | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Heat transfer coeff | 35.7076 | 35.3435 | 34.9793 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 (38) |
| Average = Sum(39)m / 12 = | 111.8345 | 111.4703 | 111.1062 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 (39) |
| HLP | 1.3487 | 1.3443 | 1.3399 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 (40) |
| HLP (average) | | | | | | | | | | | | 1.3346 (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 | 2.5159 (42) |
| Average daily hot water use (litres/day) | 93.9534 (43) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |
| Energy content (annual) | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (45) |
| Distribution loss (46)m = 0.15 x (45)m | 22.9895 | 20.1068 | 20.7484 | 18.0889 | 17.3568 | 14.9776 | 13.8789 | 15.9263 | 16.1165 | 18.7822 | 20.5022 | 22.2641 (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 | 50.9589 | 45.8390 | 48.8352 | 45.4065 | 45.0050 | 41.6999 | 43.0899 | 45.0050 | 45.4065 | 48.8352 | 49.1132 | 50.9589 (61) |
| Total heat required for water heating calculated for each month | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (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) |
| Output from w/h | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (64) |
| Heat gains from water heating, kWh/month | 63.6998 | 56.0297 | 58.2010 | 51.4488 | 49.7254 | 43.6252 | 41.5374 | 46.5545 | 47.0765 | 53.8427 | 57.7249 | 62.0918 (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 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 52.0688 | 46.2471 | 37.6106 | 28.4737 | 21.2844 | 17.9692 | 19.4163 | 25.2381 | 33.8745 | 43.0115 | 50.2008 | 53.5160 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 336.4700 | 339.9615 | 331.1630 | 312.4321 | 288.7876 | 266.5652 | 251.7193 | 248.2278 | 257.0262 | 275.7572 | 299.4016 | 321.6240 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 (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) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 (71) |
| Water heating gains (Table 5) | 85.6180 | 83.3776 | 78.2272 | 71.4566 | 66.8352 | 60.5906 | 55.8298 | 62.5732 | 65.3840 | 72.3692 | 80.1735 | 83.4567 (72) |
| Total internal gains | 580.0870 | 575.5163 | 552.9310 | 518.2926 | 482.8375 | 451.0552 | 432.8957 | 441.9693 | 462.2150 | 497.0680 | 535.7061 | 564.5269 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | Specific data g or Table 6b | Specific data or Table 6c | FF | Access factor Table 6d | Gains W | | | | | |
|-------------|----------|--------------------------|-----------------------------|---------------------------|-----------|------------------------|----------|----------|----------|----------|----------|---------------|
| East | 8.2700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 64.1595 (76) | | | | | | |
| South | 0.6800 | 46.7521 | 0.7600 | 0.7500 | 0.7700 | 12.5579 (78) | | | | | | |
| West | 3.8700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 30.0238 (80) | | | | | | |
| Solar gains | 106.7413 | 204.8092 | 329.6196 | 472.1316 | 573.1823 | 584.8623 | 557.5557 | 482.1860 | 380.2587 | 240.8024 | 132.3210 | 88.3030 (83) |
| Total gains | 686.8282 | 780.3256 | 882.5506 | 990.4242 | 1056.0198 | 1035.9175 | 990.4514 | 924.1552 | 842.4737 | 737.8705 | 668.0270 | 652.8299 (84) |

7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Th1 (C) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) | 0.9909 | 0.9835 | 0.9639 | 0.9099 | 0.7995 | 0.6337 | 0.4784 | 0.5297 | 0.7681 | 0.9407 | 0.9839 | 0.9926 (86) |
| tau | 48.7541 | 48.9134 | 49.0737 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 |
| alpha | 4.2503 | 4.2609 | 4.2716 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 |
| MIT | 19.9221 | 20.0581 | 20.2859 | 20.5644 | 20.7805 | 20.8940 | 20.9267 | 20.9212 | 20.8387 | 20.5478 | 20.1850 | 19.9026 (87) |
| Th 2 | 19.8029 | 19.8063 | 19.8097 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 (88) |
| util rest of house | 0.9881 | 0.9784 | 0.9524 | 0.8812 | 0.7392 | 0.5351 | 0.3557 | 0.4029 | 0.6796 | 0.9154 | 0.9779 | 0.9903 (89) |
| MIT 2 | 18.3892 | 18.5894 | 18.9169 | 19.3066 | 19.5790 | 19.6969 | 19.7204 | 19.7179 | 19.6505 | 19.2945 | 18.7816 | 18.3712 (90) |
| Living area fraction | 18.8902 | 19.0687 | 19.3643 | 19.7177 | 19.9717 | 20.0881 | 20.1147 | 20.1112 | 20.0388 | 19.7041 | 19.2403 | 18.8717 (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 |
| adjusted MIT | 18.7402 | 18.9187 | 19.2143 | 19.5677 | 19.8217 | 19.9381 | 19.9647 | 19.9612 | 19.8888 | 19.5541 | 19.0903 | 18.7217 (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|---------------------------|
| Useful gains | 676.2828 | 759.5212 | 834.0883 | 865.6375 | 780.9004 | 565.5621 | 367.9893 | 387.3257 | 577.7484 | 670.1446 | 649.9716 | 644.5775 (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 | 1614.9105 | 1562.6700 | 1412.6364 | 1177.7072 | 896.6266 | 589.3260 | 371.4558 | 393.1512 | 639.0805 | 988.5259 | 1323.7185 | 1603.1864 (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 | 698.3390 | 539.7161 | 430.4398 | 224.6902 | 86.1003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 236.8757 | 485.0977 | 713.2050 (98) |
| Space heating | | | | | | | | | | | | 3414.4638 (98) |
| Space heating per m2 | | | | | | | | | | | | (98) / (4) = 41.1778 (99) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|----------|----------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.1000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 0.9000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 91.9000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 65.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 3343.8710 (211) |
| Space heating requirement | 698.3390 | 539.7161 | 430.4398 | 224.6902 | 86.1003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 236.8757 | 485.0977 | 713.2050 | (98) |
| Space heating efficiency (main heating system 1) | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.9000 | 91.9000 | 91.9000 | (210) |
| Space heating fuel (main heating system) | 683.9011 | 528.5576 | 421.5406 | 220.0448 | 84.3202 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 231.9784 | 475.0685 | 698.4598 | (211) |
| Water heating requirement | 107.4368 | 83.0332 | 66.2215 | 34.5677 | 13.2462 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 36.4424 | 74.6304 | 109.7239 | (215) |
| Water heating requirement | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 | (64) |
| Efficiency of water heater (217)m | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | (216) |
| Fuel for water heating, kWh/month | 228.1812 | 200.9877 | 209.1147 | 185.4742 | 179.5718 | 158.1568 | 151.5262 | 168.9162 | 170.7817 | 194.4690 | 207.5919 | 222.7779 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 2277.5494 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 3343.8710 (211) |
| Space heating fuel - secondary | | | | | | | | | | | | | 525.3021 (215) |
| Electricity for pumps and fans: (MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840) | | | | | | | | | | | | | 46.6272 (230a) |
| mechanical ventilation fans (SFP = 0.1840) | | | | | | | | | | | | | 30.0000 (230c) |
| central heating pump | | | | | | | | | | | | | 45.0000 (230e) |
| main heating flue fan | | | | | | | | | | | | | 121.6272 (231) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 367.8206 (232) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 1.50 * 1080 * 1.00) = | | | | | | | | | | -1295.4295 | | | -1295.4295 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | | 5340.7407 (238) |

10a. Fuel costs - using Table 12 prices

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|---------------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 3343.8710 | 3.4800 | 116.3667 (240) |
| Space heating - secondary | 525.3021 | 4.2300 | 22.2203 (242) |
| Water heating (other fuel) | 2277.5494 | 3.4800 | 79.2587 (247) |
| Mechanical ventilation fans | 46.6272 | 13.1900 | 6.1501 (249) |
| Pumps and fans for heating | 75.0000 | 13.1900 | 9.8925 (249) |
| Energy for lighting | 367.8206 | 13.1900 | 48.5155 (250) |
| Additional standing charges | | | 120.0000 (251) |
| Energy saving/generation technologies | | | |
| PV Unit | -1295.4295 | 13.1900 | -170.8672 (252) |
| Total energy cost | | | 231.5367 (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|---|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | $[(255) \times (256)] / [(4) + 45.0] =$ | 0.7602 (257) |
| SAP value | | 89.3951 |
| SAP rating (Section 12) | | 89 (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 | 3343.8710 | 0.2160 | 722.2761 (261) |
| Space heating - secondary | 525.3021 | 0.0190 | 9.9807 (263) |
| Water heating (other fuel) | 2277.5494 | 0.2160 | 491.9507 (264) |
| Space and water heating | | | 1224.2075 (265) |
| Pumps and fans | 121.6272 | 0.5190 | 63.1245 (267) |
| Energy for lighting | 367.8206 | 0.5190 | 190.8989 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1295.4295 | 0.5190 | -672.3279 (269) |
| Total kg/year | | | 805.9030 (272) |
| CO2 emissions per m2 | | | 9.7200 (273) |
| EI value | | | 91.5579 |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI rating
EI band

92 (274)
A

Calculation of stars for heating and DHW

| | |
|------------------------------------|---|
| Main heating energy efficiency | $3.48 \times (1 + 0.29 \times 0.25) / 0.8950 = 4.170$, stars = 4 |
| Main heating environmental impact | $0.216 \times (1 + 0.29 \times 0.25) / 0.8950 = 0.2588$, stars = 4 |
| Water heating energy efficiency | $3.48 / 0.8950 = 3.888$, stars = 4 |
| Water heating environmental impact | $0.216 / 0.8950 = 0.2413$, stars = 4 |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

SAP 2012 WORKSHEET FOR New Build (As Designed) (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 | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-----------------------------|---------------------------|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.2500 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | (21) = (18) x (20) = | 0.2125 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.0000 | 5.0000 | 4.9000 | 4.3000 | 4.2000 | 3.9000 | 3.7000 | 3.5000 | 3.9000 | 4.2000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2500 | 1.2500 | 1.2250 | 1.0750 | 1.0500 | 0.9750 | 0.9250 | 0.8750 | 0.9750 | 1.0500 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.2656 | 0.2656 | 0.2603 | 0.2284 | 0.2231 | 0.2072 | 0.1966 | 0.1859 | 0.2072 | 0.2231 | 0.2391 | 0.2497 (22b) |
| Mechanical extract ventilation - decentralised | | | | | | | | | | | | 0.5000 (23a) |
| If mechanical ventilation: | | | | | | | | | | | | 0.5000 (23a) |
| Effective ac | 0.5156 | 0.5156 | 0.5103 | 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 | 1.8000 | 3.8160 | | (26a) |
| Opening Type 2 (Uw = 1.60) | | | 12.8200 | 1.5038 | 19.2782 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1400 | 1.1550 | 75.0000 | 618.7500 (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1838 | 5.7241 | 20.0000 | 623.0000 (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | 110.0000 | 9802.1000 (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1524 | 2.0999 | 110.0000 | 1515.8000 (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | 9.0000 | 354.6000 (30) |
| Total net area of external elements Aum(A, m2) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 53.2350 | | (33) |
| Party Wall 1 | | | 65.8300 | 0.0000 | 0.0000 | 70.0000 | 4608.1000 (32) |
| Internal Wall 2 | | | 76.5100 | | | 9.0000 | 688.5900 (32c) |
| Internal Floor 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32d) |
| Internal Ceiling 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32e) |
| Heat capacity Cm = Sum(A x k) | | | | | | (28)...(30) + (32) + (32a)...(32e) = | 19628.6200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 236.7176 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 22.8919 (36) |
| Total fabric heat loss | | | | | | (33) + (36) = | 76.1269 (37) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | 35.3435 | 35.3435 | 34.9793 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 (38) |
| Heat transfer coeff | 111.4703 | 111.4703 | 111.1062 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 110.6367 (39) |
| HLP | 1.3443 | 1.3443 | 1.3399 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 (40) |
| HLP (average) | | | | | | | | | | | | 1.3343 (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 | 2.5159 (42) |
| Average daily hot water use (litres/day) | 93.9534 (43) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|-----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |
| Energy conte | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (45) |
| Energy content (annual) | Total = Sum(45)m = 1478.2535 (45) | | | | | | | | | | | |
| Distribution loss (46)m = 0.15 x (45)m | 22.9895 | 20.1068 | 20.7484 | 18.0889 | 17.3568 | 14.9776 | 13.8789 | 15.9263 | 16.1165 | 18.7822 | 20.5022 | 22.2641 (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 | 50.9589 | 45.8390 | 48.8352 | 45.4065 | 45.0050 | 41.6999 | 43.0899 | 45.0050 | 45.4065 | 48.8352 | 49.1132 | 50.9589 (61) |
| Total heat required for water heating calculated for each month | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (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) |
| Output from w/h | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (64) |
| Heat gains from water heating, kWh/month | 63.6998 | 56.0297 | 58.2010 | 51.4488 | 49.7254 | 43.6252 | 41.5374 | 46.5545 | 47.0765 | 53.8427 | 57.7249 | 62.0918 (65) |
| Total per year (kWh/year) = Sum(64)m = 2038.4067 (64) | | | | | | | | | | | | |

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 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 52.0688 | 46.2471 | 37.6106 | 28.4737 | 21.2844 | 17.9692 | 19.4163 | 25.2381 | 33.8745 | 43.0115 | 50.2008 | 53.5160 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 336.4700 | 339.9615 | 331.1630 | 312.4321 | 288.7876 | 266.5652 | 251.7193 | 248.2278 | 257.0262 | 275.7572 | 299.4016 | 321.6240 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 (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) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 (71) |
| Water heating gains (Table 5) | 85.6180 | 83.3776 | 78.2272 | 71.4566 | 66.8352 | 60.5906 | 55.8298 | 62.5732 | 65.3840 | 72.3692 | 80.1735 | 83.4567 (72) |
| Total internal gains | 580.0870 | 575.5163 | 552.9310 | 518.2926 | 482.8375 | 451.0552 | 432.8957 | 441.9693 | 462.2150 | 497.0680 | 535.7061 | 564.5269 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| East | 8.2700 | 18.2144 | 0.7600 | 0.7500 | 0.7700 | 59.5015 (76) | | | | | | |
| South | 0.6800 | 43.9264 | 0.7600 | 0.7500 | 0.7700 | 11.7989 (78) | | | | | | |
| West | 3.8700 | 18.2144 | 0.7600 | 0.7500 | 0.7700 | 27.8441 (80) | | | | | | |
| Solar gains | 99.1445 | 190.7455 | 320.9305 | 464.5394 | 559.9997 | 565.9194 | 538.4572 | 459.2736 | 365.4138 | 223.8003 | 116.9955 | 80.3978 (83) |
| Total gains | 679.2315 | 766.2618 | 873.8615 | 982.8320 | 1042.8372 | 1016.9747 | 971.3529 | 901.2428 | 827.6288 | 720.8683 | 652.7015 | 644.9248 (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, nil,m (see Table 9a) | | | | | | | | | | | | |
| tau | 48.9134 | 48.9134 | 49.0737 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 |
| alpha | 4.2609 | 4.2609 | 4.2716 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 |
| util living area | 0.9925 | 0.9873 | 0.9721 | 0.9314 | 0.8444 | 0.7198 | 0.6170 | 0.6704 | 0.8455 | 0.9599 | 0.9879 | 0.9940 (86) |
| MIT | 19.8544 | 19.9630 | 20.1898 | 20.4725 | 20.7170 | 20.8546 | 20.9018 | 20.8870 | 20.7608 | 20.4418 | 20.0986 | 19.8304 (87) |
| Th 2 | 19.8063 | 19.8063 | 19.8097 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 (88) |
| util rest of house | 0.9903 | 0.9835 | 0.9635 | 0.9101 | 0.7964 | 0.6363 | 0.5085 | 0.5632 | 0.7833 | 0.9434 | 0.9836 | 0.9922 (89) |
| MIT 2 | 18.2931 | 18.4504 | 18.7794 | 19.1815 | 19.5030 | 19.6609 | 19.7042 | 19.6937 | 19.5653 | 19.1479 | 18.6566 | 18.2658 (90) |
| Living area fraction | fLA = Living area / (4) = 0.3268 (91) | | | | | | | | | | | |
| MIT | 18.8034 | 18.9447 | 19.2403 | 19.6034 | 19.8998 | 20.0510 | 20.0956 | 20.0837 | 19.9560 | 19.5708 | 19.1279 | 18.7772 (92) |
| Temperature adjustment | -0.1500 | | | | | | | | | | | |
| adjusted MIT | 18.6534 | 18.7947 | 19.0903 | 19.4534 | 19.7498 | 19.9010 | 19.9456 | 19.9337 | 19.8060 | 19.4208 | 18.9779 | 18.6272 (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|---------------------------|
| Utilisation | 0.9873 | 0.9792 | 0.9569 | 0.9022 | 0.7933 | 0.6429 | 0.5211 | 0.5748 | 0.7826 | 0.9363 | 0.9794 | 0.9896 (94) |
| Useful gains | 670.5846 | 750.3254 | 836.1559 | 886.6715 | 827.2609 | 653.7728 | 506.1853 | 518.0073 | 647.7290 | 674.9325 | 639.2861 | 638.2159 (95) |
| Ext temp. | 3.6000 | 4.0000 | 5.5000 | 7.8000 | 10.7000 | 13.5000 | 15.2000 | 15.0000 | 12.8000 | 9.5000 | 6.3000 | 3.5000 (96) |
| Heat loss rate W | 1678.0027 | 1649.1736 | 1509.9683 | 1286.5270 | 999.0911 | 706.6703 | 523.9098 | 544.6734 | 773.4599 | 1095.2492 | 1399.6289 | 1670.0294 (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 | 749.5191 | 604.0260 | 501.3164 | 287.8960 | 127.8417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 312.7157 | 547.4468 | 767.6692 (98) |
| Space heating | | | | | | | | | | | | 3898.4308 (98) |
| Space heating per m2 | | | | | | | | | | | | (98) / (4) = 47.0144 (99) |

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8c. Space cooling requirement

Not applicable

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|----------|----------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.1000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 0.9000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 91.9000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 65.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 3817.8322 (211) |
| Space heating requirement | 749.5191 | 604.0260 | 501.3164 | 287.8960 | 127.8417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 312.7157 | 547.4468 | 767.6692 | (98) |
| Space heating efficiency (main heating system 1) | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.9000 | 91.9000 | 91.9000 | (210) |
| Space heating fuel (main heating system) | 734.0230 | 591.5380 | 490.9519 | 281.9438 | 125.1986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 306.2504 | 536.1285 | 751.7979 | (211) |
| Water heating requirement | 115.3106 | 92.9271 | 77.1256 | 44.2917 | 19.6680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 48.1101 | 84.2226 | 118.1030 | (215) |
| Water heating requirement | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 | (64) |
| Efficiency of water heater (217)m | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | (216) |
| Fuel for water heating, kWh/month | 228.1812 | 200.9877 | 209.1147 | 185.4742 | 179.5718 | 158.1568 | 151.5262 | 168.9162 | 170.7817 | 194.4690 | 207.5919 | 222.7779 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 2277.5494 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 3817.8322 (211) |
| Space heating fuel - secondary | | | | | | | | | | | | | 599.7586 (215) |
| Electricity for pumps and fans: (MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840) | | | | | | | | | | | | | |
| mechanical ventilation fans (SFP = 0.1840) | | | | | | | | | | | | | 46.6272 (230a) |
| central heating pump | | | | | | | | | | | | | 30.0000 (230c) |
| main heating flue fan | | | | | | | | | | | | | 45.0000 (230e) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 121.6272 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | 367.8206 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 1.50 * 1037 * 1.00) = | | | | | | | | | | -1244.1879 | | | -1244.1879 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | | 5940.4000 (238) |

10a. Fuel costs - using BEDF prices (500)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---------------------------------------|---------------|------------------|------------------|-------|
| Space heating - main system 1 | 3817.8322 | 3.6300 | 138.5873 | (240) |
| Space heating - secondary | 599.7586 | 5.1600 | 30.9475 | (242) |
| Water heating (other fuel) | 2277.5494 | 3.6300 | 82.6750 | (247) |
| Mechanical ventilation fans | 46.6272 | 19.4400 | 9.0643 | (249) |
| Pumps and fans for heating | 75.0000 | 19.4400 | 14.5800 | (249) |
| Energy for lighting | 367.8206 | 19.4400 | 71.5043 | (250) |
| Additional standing charges | | | 95.0000 | (251) |
| Energy saving/generation technologies | | | | |
| PV Unit | -1244.1879 | 19.4400 | -241.8701 | (252) |
| Total energy cost | | | 200.4884 | (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 | 3817.8322 | 0.2160 | 824.6517 | (261) |
| Space heating - secondary | 599.7586 | 0.0190 | 11.3954 | (263) |
| Water heating (other fuel) | 2277.5494 | 0.2160 | 491.9507 | (264) |
| Space and water heating | | | 1327.9978 | (265) |
| Pumps and fans | 121.6272 | 0.5190 | 63.1245 | (267) |
| Energy for lighting | 367.8206 | 0.5190 | 190.8989 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit | -1244.1879 | 0.5190 | -645.7335 | (269) |
| Total kg/year | | | 936.2877 | (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 | 3817.8322 | 1.2200 | 4657.7552 | (261) |
| Space heating - secondary | 599.7586 | 1.0400 | 623.7489 | (263) |
| Water heating (other fuel) | 2277.5494 | 1.2200 | 2778.6103 | (264) |
| Space and water heating | | | 8060.1144 | (265) |
| Pumps and fans | 121.6272 | 3.0700 | 373.3955 | (267) |

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| | | | |
|---|------------|--------|------------------|
| Energy for lighting | 367.8206 | 3.0700 | 1129.2092 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1244.1879 | 3.0700 | -3819.6569 (269) |
| Primary energy kWh/year | | | 5743.0623 (272) |
| Primary energy kWh/m ² /year | | | 69.2603 (273) |

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
 Current environmental impact rating: A 92

(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 | Recommended |
| O | Not considered |
| P | Not considered |
| R | Not considered |
| S | Not considered |
| T | Not considered |
| U Solar photovoltaic panels | Already installed |
| 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 |
| N Solar water heating | + 1.2 | -£ 24 | -176 kg (18.8%) |

| | | | |
|----------------------|------------------------|------------------------|----------------------|
| Recommended measures | Typical annual savings | Energy efficiency | Environmental impact |
| Solar water heating | £24 | 2.12 kg/m ² | B 91 A 93 |
| Total Savings | £24 | 2.12 kg/m ² | |

Potential energy efficiency rating: B 91
 Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 500 TEST (30 Jun 2022)
 Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, North East England):

| | Current | Potential | Saving |
|----------------------------------|-----------------------|-----------------------|-----------------------|
| Electricity | £95 | £105 | -£10 |
| Mains gas | £316 | £282 | £34 |
| Wood | £31 | £31 | £0 |
| Space heating | £288 | £288 | £0 |
| Water heating | £83 | £58 | £24 |
| Lighting | £72 | £72 | £0 |
| Generated (PV) | -£242 | -£242 | £0 |
| Total cost of fuels | £200 | £176 | £24 |
| Total cost of uses | £201 | £176 | £24 |
| Delivered energy | 72 kWh/m ² | 61 kWh/m ² | 11 kWh/m ² |
| Carbon dioxide emissions | 0.9 tonnes | 0.8 tonnes | 0.2 tonnes |
| CO2 emissions per m ² | 11 kg/m ² | 9 kg/m ² | 2 kg/m ² |
| Primary energy | 69 kWh/m ² | 57 kWh/m ² | 12 kWh/m ² |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

| | Area (m ²) | Storey height (m) | Volume (m ³) |
|--|------------------------|-------------------|--|
| Ground floor | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m ³ per hour |
|---|--------------|-------------------|-------|-----------------------------|---------------------------|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.2500 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | (21) = (18) x (20) = | 0.2125 (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 | 0.2709 | 0.2656 | 0.2603 | 0.2338 | 0.2284 | 0.2019 | 0.2019 | 0.1966 | 0.2125 | 0.2284 | 0.2391 | 0.2497 (22b) |
| Mechanical extract ventilation - decentralised | | | | | | | | | | | | 0.5000 (23a) |
| If mechanical ventilation: | | | | | | | | | | | | 0.5000 (23a) |
| Effective ac | 0.5209 | 0.5156 | 0.5103 | 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 m ² | Openings m ² | NetArea m ² | U-value W/m ² K | A x U W/K | K-value kJ/m ² K | A x K kJ/K |
|--|----------------------|-------------------------|------------------------|----------------------------|-----------|--------------------------------------|-----------------|
| Opening Type 1 | | | 2.1200 | 1.8000 | 3.8160 | | (26a) |
| Opening Type 2 (Uw = 1.60) | | | 12.8200 | 1.5038 | 19.2782 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1400 | 1.1550 | 75.0000 | 618.7500 (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1838 | 5.7241 | 20.0000 | 623.0000 (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | 110.0000 | 9802.1000 (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1524 | 2.0999 | 110.0000 | 1515.8000 (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | 9.0000 | 354.6000 (30) |
| Total net area of external elements Aum(A, m ²) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 53.2350 | | (33) |
| Party Wall 1 | | | 65.8300 | 0.0000 | 0.0000 | 70.0000 | 4608.1000 (32) |
| Internal Wall 2 | | | 76.5100 | | | 9.0000 | 688.5900 (32c) |
| Internal Floor 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32d) |
| Internal Ceiling 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32e) |
| Heat capacity Cm = Sum(A x k) | | | | | | (28)...(30) + (32) + (32a)...(32e) = | 19628.6200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K | | | | | | | 236.7176 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 22.8919 (36) |
| Total fabric heat loss | | | | | | (33) + (36) = | 76.1269 (37) |

| (38)m | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | 35.7076 | 35.3435 | 34.9793 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 (38) |
| Heat transfer coeff | 111.8345 | 111.4703 | 111.1062 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 110.6671 (39) |
| HLP | 1.3487 | 1.3443 | 1.3399 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 (40) |
| HLP (average) | | | | | | | | | | | | 1.3346 (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 | 2.5159 (42) |
| Average daily hot water use (litres/day) | 93.9534 (43) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------------|
| Daily hot water use | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 (44) |
| Energy content (annual) | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 (45) |
| Distribution loss (46)m = 0.15 x (45)m | 22.9895 | 20.1068 | 20.7484 | 18.0889 | 17.3568 | 14.9776 | 13.8789 | 15.9263 | 16.1165 | 18.7822 | 20.5022 | 22.2641 (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 | 50.9589 | 45.8390 | 48.8352 | 45.4065 | 45.0050 | 41.6999 | 43.0899 | 45.0050 | 45.4065 | 48.8352 | 49.1132 | 50.9589 (61) |
| Total heat required for water heating calculated for each month | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 (62) |
| Aperture area of solar collector | | | | | | | | | | | | 1.8000 (H1) |
| Zero-loss collector efficiency | | | | | | | | | | | | 0.7000 (H2) |
| Collector heat loss coefficient | | | | | | | | | | | | 1.8000 (H3) |
| Collector 2nd order heat loss coefficient | | | | | | | | | | | | 0.0050 (H3a) |
| Collector effective heat loss coefficient | | | | | | | | | | | | 1.8063 (H3b) |
| Collector performance ratio | | | | | | | | | | | | 2.5804 (H4) |
| Annual solar radiation per m2 | | | | | | | | | | | | 1079.5246 (H5) |
| Overshading factor | | | | | | | | | | | | 0.8000 (H6) |
| Solar energy available | | | | | | | | | | | | 1813.6014 (H7) |
| Adjustment factor for showers | | | | | | | | | | | | 1.0000 (H7a) |
| Solar-to-load ratio | | | | | | | | | | | | 1.2269 (H8) |
| Utilisation factor | | | | | | | | | | | | 0.5574 (H9) |
| Collector performance factor | | | | | | | | | | | | 0.8793 (H10) |
| Dedicated solar storage volume | | | | | | | | | | | | 75.0000 (H11) |
| Effective solar volume | | | | | | | | | | | | 75.0000 (H13) |
| Daily hot water demand | | | | | | | | | | | | 93.9534 (H14) |
| Volume ratio Veff/V | | | | | | | | | | | | 0.7983 (H15) |
| Solar storage volume factor | | | | | | | | | | | | 0.9549 (H16) |
| Solar input | -24.6143 | -41.0742 | -69.9540 | -93.7522 | -115.8229 | -113.8723 | -112.3675 | -98.1760 | -76.8915 | -52.5079 | -29.1961 | -848.8268 (H17) |
| Solar input (sum of months) = Sum(63)m = | | | | | | | | | | | | -848.8268 (63) |
| Output from w/h | 179.6079 | 138.8099 | 117.2037 | 72.2473 | 44.8938 | 27.6780 | 23.2485 | 53.0040 | 75.9581 | 121.5419 | 156.5986 | 178.7882 (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | 1189.5799 (64) |
| Heat gains from water heating, kWh/month | 63.6998 | 56.0297 | 58.2010 | 51.4488 | 49.7254 | 43.6252 | 41.5374 | 46.5545 | 47.0765 | 53.8427 | 57.7249 | 62.0918 (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 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 52.0688 | 46.2471 | 37.6106 | 28.4737 | 21.2844 | 17.9692 | 19.4163 | 25.2381 | 33.8745 | 43.0115 | 50.2008 | 53.5160 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 336.4700 | 339.9615 | 331.1630 | 312.4321 | 288.7876 | 266.5652 | 251.7193 | 248.2278 | 257.0262 | 275.7572 | 299.4016 | 321.6240 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 (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) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 (71) |
| Water heating gains (Table 5) | 85.6180 | 83.3776 | 78.2272 | 71.4566 | 66.8352 | 60.5906 | 55.8298 | 62.5732 | 65.3840 | 72.3692 | 80.1735 | 83.4567 (72) |
| Total internal gains | 580.0870 | 575.5163 | 552.9310 | 518.2926 | 482.8375 | 451.0552 | 432.8957 | 441.9693 | 462.2150 | 497.0680 | 535.7061 | 564.5269 (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | Specific data or Table 6b | Specific data or Table 6c | FF | Access factor Table 6d | Gains W | | | | | |
|-------------|----------|--------------------------|---------------------------|---------------------------|-----------|------------------------|----------|----------|----------|----------|----------|---------------|
| East | 8.2700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 64.1595 (76) | | | | | | |
| South | 0.6800 | 46.7521 | 0.7600 | 0.7500 | 0.7700 | 12.5579 (78) | | | | | | |
| West | 3.8700 | 19.6403 | 0.7600 | 0.7500 | 0.7700 | 30.0238 (80) | | | | | | |
| Solar gains | 106.7413 | 204.8092 | 329.6196 | 472.1316 | 573.1823 | 584.8623 | 557.5557 | 482.1860 | 380.2587 | 240.8024 | 132.3210 | 88.3030 (83) |
| Total gains | 686.8282 | 780.3256 | 882.5506 | 990.4242 | 1056.0198 | 1035.9175 | 990.4514 | 924.1552 | 842.4737 | 737.8705 | 668.0270 | 652.8299 (84) |

7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, Thl (C) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | |
| tau | 48.7541 | 48.9134 | 49.0737 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 (85) |
| alpha | 4.2503 | 4.2609 | 4.2716 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 |
| util living area | 0.9909 | 0.9835 | 0.9639 | 0.9099 | 0.7995 | 0.6337 | 0.4784 | 0.5297 | 0.7681 | 0.9407 | 0.9839 | 0.9926 (86) |
| MIT | 19.9221 | 20.0581 | 20.2859 | 20.5644 | 20.7805 | 20.8940 | 20.9267 | 20.9212 | 20.8387 | 20.5478 | 20.1850 | 19.9026 (87) |
| Th 2 | 19.8029 | 19.8063 | 19.8097 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 (88) |
| util rest of house | 0.9881 | 0.9784 | 0.9524 | 0.8812 | 0.7392 | 0.5351 | 0.3557 | 0.4029 | 0.6796 | 0.9154 | 0.9779 | 0.9903 (89) |
| MIT 2 | 18.3892 | 18.5884 | 18.9169 | 19.3066 | 19.5790 | 19.6969 | 19.7204 | 19.7179 | 19.6505 | 19.2945 | 18.7816 | 18.3712 (90) |
| Living area fraction | 18.8902 | 19.0687 | 19.3643 | 19.7177 | 19.9717 | 20.0881 | 20.1147 | 20.1112 | 20.0388 | 19.7041 | 19.2403 | 18.8717 (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 |

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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

adjusted MIT 18.7402 18.9187 19.2143 19.5677 19.8217 19.9381 19.9647 19.9612 19.8888 19.5541 19.0903 18.7217 (93)

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|-----------|-------|
| Utilisation | 0.9846 | 0.9733 | 0.9451 | 0.8740 | 0.7395 | 0.5460 | 0.3715 | 0.4191 | 0.6858 | 0.9082 | 0.9730 | 0.9874 | (94) |
| Useful gains | 676.2828 | 759.5212 | 834.0883 | 865.6375 | 780.9004 | 565.5621 | 367.9893 | 387.3257 | 577.7484 | 670.1446 | 649.9716 | 644.5775 | (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 | 1614.9105 | 1562.6700 | 1412.6364 | 1177.7072 | 896.6266 | 589.3260 | 371.4558 | 393.1512 | 639.0805 | 988.5259 | 1323.7185 | 1603.1864 | (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 | 698.3390 | 539.7161 | 430.4398 | 224.6902 | 86.1003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 236.8757 | 485.0977 | 713.2050 | (98) |
| Space heating per m2 | | | | | | | | | | | (98) / (4) = | 41.1778 | (99) |

8c. Space cooling requirement

Not applicable

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

| | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|----------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.1000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 0.9000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 91.9000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 65.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 3343.8710 (211) |
| Space heating requirement | 698.3390 | 539.7161 | 430.4398 | 224.6902 | 86.1003 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 236.8757 | 485.0977 | 713.2050 | (98) |
| Space heating efficiency (main heating system 1) | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.9000 | 91.9000 | 91.9000 | (210) |
| Space heating fuel (main heating system) | 683.9011 | 528.5576 | 421.5406 | 220.0448 | 84.3202 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 231.9784 | 475.0685 | 698.4598 | (211) |
| Water heating requirement | 107.4368 | 83.0332 | 66.2215 | 34.5677 | 13.2462 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 36.4424 | 74.6304 | 109.7239 | (215) |
| Water heating requirement | 179.6079 | 138.8099 | 117.2037 | 72.2473 | 44.8938 | 27.6780 | 23.2485 | 53.0040 | 75.9581 | 121.5419 | 156.5986 | 178.7882 | (64) |
| Efficiency of water heater (217)m | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | (216) |
| Fuel for water heating, kWh/month | 200.6792 | 155.0948 | 130.9538 | 80.7232 | 50.1607 | 30.9251 | 25.9760 | 59.2224 | 84.8694 | 135.8010 | 174.9705 | 199.7634 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1329.1396 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 3343.8710 (211) |
| Space heating fuel - secondary | | | | | | | | | | | | | 525.3021 (215) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| (MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840 | | | | | | | | | | | | | |
| mechanical ventilation fans (SFP = 0.1840) | | | | | | | | | | | | | 46.6272 (230a) |
| central heating pump | | | | | | | | | | | | | 30.0000 (230c) |
| main heating flue fan | | | | | | | | | | | | | 45.0000 (230e) |
| pump for solar water heating | | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 171.6272 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | 367.8206 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 1.50 * 1080 * 1.00) = | | | | | | | | | | | | | -1295.4295 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4442.3309 (238) |

10a. Fuel costs - using Table 12 prices

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---------------------------------------|---------------|------------------|------------------|-------|
| Space heating - main system 1 | 3343.8710 | 3.4800 | 116.3667 | (240) |
| Space heating - secondary | 525.3021 | 4.2300 | 22.2203 | (242) |
| Water heating (other fuel) | 1329.1396 | 3.4800 | 46.2541 | (247) |
| Mechanical ventilation fans | 46.6272 | 13.1900 | 6.1501 | (249) |
| Pumps and fans for heating | 75.0000 | 13.1900 | 9.8925 | (249) |
| Pump for solar water heating | 50.0000 | 13.1900 | 6.5950 | (249) |
| Energy for lighting | 367.8206 | 13.1900 | 48.5155 | (250) |
| Additional standing charges | | | 120.0000 | (251) |
| Energy saving/generation technologies | | | | |
| PV Unit | -1295.4295 | 13.1900 | -170.8672 | (252) |
| Total energy cost | | | 205.1271 | (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|----------------------------------|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | | 0.6735 (257) |
| SAP value | [(255) x (256)] / [(4) + 45.0] = | 90.6048 |
| SAP rating (Section 12) | | 91 (258) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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 | 3343.8710 | 0.2160 | 722.2761 (261) |
| Space heating - secondary | 525.3021 | 0.0190 | 9.9807 (263) |
| Water heating (other fuel) | 1329.1396 | 0.2160 | 287.0942 (264) |
| Space and water heating | | | 1019.3510 (265) |
| Pumps and fans | 171.6272 | 0.5190 | 89.0745 (267) |
| Energy for lighting | 367.8206 | 0.5190 | 190.8989 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1295.4295 | 0.5190 | -672.3279 (269) |
| Total kg/year | | | 626.9965 (272) |
| CO2 emissions per m2 | | | 7.5600 (273) |
| EI value | | | 93.4320 |
| EI rating | | | 93 (274) |
| EI band | | | A |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

| | Area (m2) | Storey height (m) | Volume (m3) |
|--|--------------|---------------------------------|-----------------------|
| Ground floor | 8.2500 (1b) | x 2.6000 (2b) | = 21.4500 (1b) - (3b) |
| First floor | 39.4000 (1c) | x 2.4000 (2c) | = 94.5600 (1c) - (3c) |
| Second floor | 35.2700 (1d) | x 2.6000 (2d) | = 91.7020 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 82.9200 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 207.7120 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-----------------------------|---------------------------|
| Number of chimneys | 0 | + | 0 | = | 0 * 40 = 0.0000 (6a) |
| Number of open flues | 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 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.2500 (18) |
| Number of sides sheltered | | | | | 2 (19) |
| Shelter factor | | | | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | | (21) = (18) x (20) = | 0.2125 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.0000 | 5.0000 | 4.9000 | 4.3000 | 4.2000 | 3.9000 | 3.7000 | 3.5000 | 3.9000 | 4.2000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2500 | 1.2500 | 1.2250 | 1.0750 | 1.0500 | 0.9750 | 0.9250 | 0.8750 | 0.9750 | 1.0500 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.2656 | 0.2656 | 0.2603 | 0.2284 | 0.2231 | 0.2072 | 0.1966 | 0.1859 | 0.2072 | 0.2231 | 0.2391 | 0.2497 (22b) |
| Mechanical extract ventilation - decentralised | | | | | | | | | | | | 0.5000 (23a) |
| If mechanical ventilation: | | | | | | | | | | | | 0.5000 (23a) |
| Effective ac | 0.5156 | 0.5156 | 0.5103 | 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 | 1.8000 | 3.8160 | | (26a) |
| Opening Type 2 (Uw = 1.60) | | | 12.8200 | 1.5038 | 19.2782 | | (27) |
| Heat Loss Floor 1 | | | 8.2500 | 0.1400 | 1.1550 | 75.0000 | 618.7500 (28a) |
| Heat Loss Floor 2 | | | 31.1500 | 0.1838 | 5.7241 | 20.0000 | 623.0000 (28b) |
| External Wall 1 | 104.0500 | 14.9400 | 89.1100 | 0.1800 | 16.0398 | 110.0000 | 9802.1000 (29a) |
| Wall To Garage | 13.7800 | | 13.7800 | 0.1524 | 2.0999 | 110.0000 | 1515.8000 (29a) |
| External Roof 2 | 39.4000 | | 39.4000 | 0.1300 | 5.1220 | 9.0000 | 354.6000 (30) |
| Total net area of external elements Aum(A, m2) | | | 196.6300 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 53.2350 | | (33) |
| Party Wall 1 | | | 65.8300 | 0.0000 | 0.0000 | 70.0000 | 4608.1000 (32) |
| Internal Wall 2 | | | 76.5100 | | | 9.0000 | 688.5900 (32c) |
| Internal Floor 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32d) |
| Internal Ceiling 1 | | | 39.3800 | | | 18.0000 | 708.8400 (32e) |
| Heat capacity Cm = Sum(A x k) | | | | | | (28)...(30) + (32) + (32a)...(32e) = | 19628.6200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 236.7176 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 22.8919 (36) |
| Total fabric heat loss | | | | | | (33) + (36) = | 76.1269 (37) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | 35.3435 | 35.3435 | 34.9793 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 | 34.2725 (38) |
| Heat transfer coeff | 111.4703 | 111.4703 | 111.1062 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 | 110.3993 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 110.6367 (39) |
| HLP | 1.3443 | 1.3443 | 1.3399 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 | 1.3314 (40) |
| HLP (average) | | | | | | | | | | | | 1.3343 (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 | 2.5159 (42) |
| Average daily hot water use (litres/day) | 93.9534 (43) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|--------------------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------------|------|
| Daily hot water use | 103.3488 | 99.5906 | 95.8325 | 92.0744 | 88.3162 | 84.5581 | 84.5581 | 88.3162 | 92.0744 | 95.8325 | 99.5906 | 103.3488 | (44) |
| Energy conte | 153.2633 | 134.0450 | 138.3225 | 120.5929 | 115.7117 | 99.8504 | 92.5261 | 106.1751 | 107.4431 | 125.2146 | 136.6815 | 148.4273 | (45) |
| Energy content (annual) | Total = Sum(45)m = | | | | | | | | | | | 1478.2535 (45) | |
| Distribution loss (46)m = 0.15 x (45)m | 22.9895 | 20.1068 | 20.7484 | 18.0889 | 17.3568 | 14.9776 | 13.8789 | 15.9263 | 16.1165 | 18.7822 | 20.5022 | 22.2641 | (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 | 50.9589 | 45.8390 | 48.8352 | 45.4065 | 45.0050 | 41.6999 | 43.0899 | 45.0050 | 45.4065 | 48.8352 | 49.1132 | 50.9589 | (61) |
| Total heat required for water heating calculated for each month | 204.2222 | 179.8840 | 187.1577 | 165.9994 | 160.7167 | 141.5503 | 135.6160 | 151.1800 | 152.8497 | 174.0498 | 185.7947 | 199.3862 | (62) |
| Aperture area of solar collector | 3.0000 (H1) | | | | | | | | | | | | |
| Zero-loss collector efficiency | 0.7000 (H2) | | | | | | | | | | | | |
| Collector heat loss coefficient | 1.8000 (H3) | | | | | | | | | | | | |
| Collector 2nd order heat loss coefficient | 0.0050 (H3a) | | | | | | | | | | | | |
| Collector effective heat loss coefficient | 1.8063 (H3b) | | | | | | | | | | | | |
| Collector performance ratio | 2.5804 (H4) | | | | | | | | | | | | |
| Annual solar radiation per m2 | 1036.8233 (H5) | | | | | | | | | | | | |
| Overshading factor | 0.8000 (H6) | | | | | | | | | | | | |
| Solar energy available | 1741.8631 (H7) | | | | | | | | | | | | |
| Adjustment factor for showers | 1.0000 (H7a) | | | | | | | | | | | | |
| Solar-to-load ratio | 1.1783 (H8) | | | | | | | | | | | | |
| Utilisation factor | 0.5720 (H9) | | | | | | | | | | | | |
| Collector performance factor | 0.8793 (H10) | | | | | | | | | | | | |
| Dedicated solar storage volume | 75.0000 (H11) | | | | | | | | | | | | |
| Effective solar volume | 75.0000 (H13) | | | | | | | | | | | | |
| Daily hot water demand | 93.9534 (H14) | | | | | | | | | | | | |
| Volume ratio Veff/V | 0.7983 (H15) | | | | | | | | | | | | |
| Solar storage volume factor | 0.9549 (H16) | | | | | | | | | | | | |
| Solar input | -23.5319 | -39.3646 | -70.0468 | -94.7906 | -116.2123 | -113.1301 | -111.4310 | -96.0657 | -75.9667 | -50.2083 | -26.5691 | -19.3038 | (63) |
| Solar input (sum of months) = Sum(63)m = | | | | | | | | | | | | -836.6210 (63) | |
| Output from w/h | 180.6902 | 140.5194 | 117.1109 | 71.2088 | 44.5044 | 28.4203 | 24.1849 | 55.1144 | 76.8829 | 123.8415 | 159.2256 | 180.0824 | (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | 1201.7857 (64) | |
| Heat gains from water heating, kWh/month | 63.6998 | 56.0297 | 58.2010 | 51.4488 | 49.7254 | 43.6252 | 41.5374 | 46.5545 | 47.0765 | 53.8427 | 57.7249 | 62.0918 | (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 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | 150.9561 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 52.0688 | 46.2471 | 37.6106 | 28.4737 | 21.2844 | 17.9692 | 19.4163 | 25.2381 | 33.8745 | 43.0115 | 50.2008 | 53.5160 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 336.4700 | 339.9615 | 331.1630 | 312.4321 | 288.7876 | 266.5652 | 251.7193 | 248.2278 | 257.0262 | 275.7572 | 299.4016 | 321.6240 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | 52.6115 | (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) | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | -100.6374 | (71) |
| Water heating gains (Table 5) | 85.6180 | 83.3776 | 78.2272 | 71.4566 | 66.8352 | 60.5906 | 55.8298 | 62.5732 | 65.3840 | 72.3692 | 80.1735 | 83.4567 | (72) |
| Total internal gains | 580.0870 | 575.5163 | 552.9310 | 518.2926 | 482.8375 | 451.0552 | 432.8957 | 441.9693 | 462.2150 | 497.0680 | 535.7061 | 564.5269 | (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|----------|------|
| East | 8.2700 | 18.2144 | 0.7600 | 0.7500 | 0.7700 | 59.5015 (76) | | | | | | | |
| South | 0.6800 | 43.9264 | 0.7600 | 0.7500 | 0.7700 | 11.7989 (78) | | | | | | | |
| West | 3.8700 | 18.2144 | 0.7600 | 0.7500 | 0.7700 | 27.8441 (80) | | | | | | | |
| Solar gains | 99.1445 | 190.7455 | 320.9305 | 464.5394 | 559.9997 | 565.9194 | 538.4572 | 459.2736 | 365.4138 | 223.8003 | 116.9955 | 80.3978 | (83) |
| Total gains | 679.2315 | 766.2618 | 873.8615 | 982.8320 | 1042.8372 | 1016.9747 | 971.3529 | 901.2428 | 827.6288 | 720.8683 | 652.7015 | 644.9248 | (84) |

7. Mean internal temperature (heating season)

| Temperature during heating periods in the living area from Table 9, T _{hl} (C) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | 21.0000 (85) |
| tau | 48.9134 | 48.9134 | 49.0737 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | 49.3879 | |
| alpha | 4.2609 | 4.2609 | 4.2716 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | 4.2925 | |
| util living area | 0.9925 | 0.9873 | 0.9721 | 0.9314 | 0.8444 | 0.7198 | 0.6170 | 0.6704 | 0.8455 | 0.9599 | 0.9879 | 0.9940 | (86) |
| MIT | 19.8544 | 19.9630 | 20.1898 | 20.4725 | 20.7170 | 20.8546 | 20.9018 | 20.8870 | 20.7608 | 20.4418 | 20.0986 | 19.8304 | (87) |
| Th 2 | 19.8063 | 19.8063 | 19.8097 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | 19.8163 | (88) |
| util rest of house | 0.9903 | 0.9835 | 0.9635 | 0.9101 | 0.7964 | 0.6363 | 0.5085 | 0.5632 | 0.7833 | 0.9434 | 0.9836 | 0.9922 | (89) |
| MIT 2 | 18.2931 | 18.4504 | 18.7794 | 19.1815 | 19.5030 | 19.6609 | 19.7042 | 19.6937 | 19.5653 | 19.1479 | 18.6566 | 18.2658 | (90) |
| Living area fraction | f _{LA} = Living area / (4) = | | | | | | | | | | | | |
| MIT | 18.8034 | 18.9447 | 19.2403 | 19.6034 | 19.8998 | 20.0510 | 20.0956 | 20.0837 | 19.9560 | 19.5708 | 19.1279 | 18.7772 | (92) |
| Temperature adjustment | | | | | | | | | | | | | -0.1500 |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

adjusted MIT 18.6534 18.7947 19.0903 19.4534 19.7498 19.9010 19.9456 19.9337 19.8060 19.4208 18.9779 18.6272 (93)

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|---------------------------|
| Utilisation | 0.9873 | 0.9792 | 0.9569 | 0.9022 | 0.7933 | 0.6429 | 0.5211 | 0.5748 | 0.7826 | 0.9363 | 0.9794 | 0.9896 | (94) |
| Useful gains | 670.5846 | 750.3254 | 836.1559 | 886.6715 | 827.2609 | 653.7728 | 506.1853 | 518.0073 | 647.7290 | 674.9325 | 639.2861 | 638.2159 | (95) |
| Ext temp. | 3.6000 | 4.0000 | 5.5000 | 7.8000 | 10.7000 | 13.5000 | 15.2000 | 15.0000 | 12.8000 | 9.5000 | 6.3000 | 3.5000 | (96) |
| Heat loss rate W | 1678.0027 | 1649.1736 | 1509.9683 | 1286.5270 | 999.0911 | 706.6703 | 523.9098 | 544.6734 | 773.4599 | 1095.2492 | 1399.6289 | 1670.0294 | (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 | 749.5191 | 604.0260 | 501.3164 | 287.8960 | 127.8417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 312.7157 | 547.4468 | 767.6692 | (98) |
| Space heating | | | | | | | | | | | | | (98) |
| Space heating per m2 | | | | | | | | | | | | | (98) / (4) = 47.0144 (99) |

8c. Space cooling requirement

Not applicable

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

| | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|----------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.1000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 0.9000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 91.9000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 65.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 3817.8322 (211) |
| Space heating requirement | 749.5191 | 604.0260 | 501.3164 | 287.8960 | 127.8417 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 312.7157 | 547.4468 | 767.6692 | (98) |
| Space heating efficiency (main heating system 1) | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 91.9000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 91.9000 | 91.9000 | 91.9000 | (210) |
| Space heating fuel (main heating system) | 734.0230 | 591.5380 | 490.9519 | 281.9438 | 125.1986 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 306.2504 | 536.1285 | 751.7979 | (211) |
| Water heating requirement | 115.3106 | 92.9271 | 77.1256 | 44.2917 | 19.6680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 48.1101 | 84.2226 | 118.1030 | (215) |
| Water heating requirement | 180.6902 | 140.5194 | 117.1109 | 71.2088 | 44.5044 | 28.4203 | 24.1849 | 55.1144 | 76.8829 | 123.8415 | 159.2256 | 180.0824 | (64) |
| Efficiency of water heater (217)m | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | 89.5000 | (216) |
| Fuel for water heating, kWh/month | 201.8885 | 157.0049 | 130.8502 | 79.5629 | 49.7256 | 31.7545 | 27.0223 | 61.5803 | 85.9027 | 138.3704 | 177.9057 | 201.2094 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1342.7774 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 3817.8322 (211) |
| Space heating fuel - secondary | | | | | | | | | | | | | 599.7586 (215) |
| Electricity for pumps and fans: | | | | | | | | | | | | | |
| (MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840 | | | | | | | | | | | | | |
| mechanical ventilation fans (SFP = 0.1840) | | | | | | | | | | | | | 46.6272 (230a) |
| central heating pump | | | | | | | | | | | | | 30.0000 (230c) |
| main heating flue fan | | | | | | | | | | | | | 45.0000 (230e) |
| pump for solar water heating | | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 171.6272 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | 367.8206 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 1.50 * 1037 * 1.00) = | | | | | | | | | | | | | -1244.1879 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | | 5055.6280 (238) |

10a. Fuel costs - using BEDF prices (500)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year | |
|---------------------------------------|---------------|------------------|------------------|-------|
| Space heating - main system 1 | 3817.8322 | 3.6300 | 138.5873 | (240) |
| Space heating - secondary | 599.7586 | 5.1600 | 30.9475 | (242) |
| Water heating (other fuel) | 1342.7774 | 3.6300 | 48.7428 | (247) |
| Mechanical ventilation fans | 46.6272 | 19.4400 | 9.0643 | (249) |
| Pumps and fans for heating | 75.0000 | 19.4400 | 14.5800 | (249) |
| Pump for solar water heating | 50.0000 | 19.4400 | 9.7200 | (249) |
| Energy for lighting | 367.8206 | 19.4400 | 71.5043 | (250) |
| Additional standing charges | | | 95.0000 | (251) |
| Energy saving/generation technologies | | | | |
| PV Unit | -1244.1879 | 19.4400 | -241.8701 | (252) |
| Total energy cost | | | 176.2762 | (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 | 3817.8322 | 0.2160 | 824.6517 | (261) |
| Space heating - secondary | 599.7586 | 0.0190 | 11.3954 | (263) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | |
|---------------------------------------|------------|--------|-----------------|
| Water heating (other fuel) | 1342.7774 | 0.2160 | 290.0399 (264) |
| Space and water heating | | | 1126.0871 (265) |
| Pumps and fans | 171.6272 | 0.5190 | 89.0745 (267) |
| Energy for lighting | 367.8206 | 0.5190 | 190.8989 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1244.1879 | 0.5190 | -645.7335 (269) |
| Total kg/year | | | 760.3269 (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 | 3817.8322 | 1.2200 | 4657.7552 (261) |
| Space heating - secondary | 599.7586 | 1.0400 | 623.7489 (263) |
| Water heating (other fuel) | 1342.7774 | 1.2200 | 1638.1884 (264) |
| Space and water heating | | | 6919.6925 (265) |
| Pumps and fans | 171.6272 | 3.0700 | 526.8955 (267) |
| Energy for lighting | 367.8206 | 3.0700 | 1129.2092 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1244.1879 | 3.0700 | -3819.6569 (269) |
| Primary energy kWh/year | | | 4756.1404 (272) |
| Primary energy kWh/m2/year | | | 57.3582 (273) |

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

Overheating Calculation Input Data

| | |
|---|---|
| Dwelling type | SemiDetached House |
| Number of storeys | 3 |
| Cross ventilation possible | No |
| SAP Region | North East England |
| Front of dwelling faces | North |
| Overshading | Average or unknown |
| Thermal mass parameter | 236.7 (calculated from construction elements) |
| Night ventilation | No |
| Ventilation rate during hot weather (ach) | 2.50 (Windows half open) |

Overheating Calculation

| | |
|--|-------------|
| Summer ventilation heat loss coefficient | 171.36 (P1) |
| Transmission heat loss coefficient | 76.13 (37) |
| Summer heat loss coefficient | 247.49 (P2) |

Overhangs

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

Solar shading

| Orientation | Z_blinds | Solar access | Z_overhangs | Z_summer |
|-------------|----------|--------------|-------------|------------|
| East | 0.800 | 0.90 | 1.000 | 0.720 (P8) |
| South | 0.800 | 0.90 | 1.000 | 0.720 (P8) |
| West | 0.800 | 0.90 | 1.000 | 0.720 (P8) |

| [Jul] | Area m2 | Solar flux Table 6a W/m2 | Specific data g or Table 6b | FF Specific data or Table 6c | Shading | Gains W |
|-------|---------|--------------------------|-----------------------------|------------------------------|---------|----------|
| East | 8.2700 | 111.2086 | 0.7600 | 0.7500 | 0.7200 | 339.6986 |
| South | 0.6800 | 110.4126 | 0.7600 | 0.7500 | 0.7200 | 27.7318 |
| West | 3.8700 | 111.2086 | 0.7600 | 0.7500 | 0.7200 | 158.9641 |

total: 526.3945

| | Jun | Jul | Aug |
|--|-----------------|-----------------|-----------------|
| Solar gains | 544 | 526 | 450 (P3) |
| Internal gains | 448 | 430 | 439 |
| Total summer gains | 992 | 956 | 889 (P5) |
| Summer gain/loss ratio | 4.01 | 3.86 | 3.59 (P6) |
| Summer external temperature | 13.80 | 15.80 | 15.60 |
| Thermal mass temperature increment (TMP = 236.7) | 0.34 | 0.34 | 0.34 |
| Threshold temperature | 18.15 | 20.01 | 19.54 (P7) |
| Likelihood of high internal temperature | Not significant | Not significant | Not significant |

Assessment of likelihood of high internal temperature: Not significant