

ASSESSMENT NOTES

Calculation Type: New Build (As Designed)



| | | | |
|----------------------|---------------|----------------|----------------------|
| Property Reference | Plot 002 | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 2 | Prop Type Ref | Washington Eaves END |
| Property | 2 bed, 1 bath | | |

| | | | | | |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating | 83 B | DER | 18.75 | TER | 19.83 |
| Environmental | 87 B | % DER<TER | 5.47 | | |
| CO ₂ Emissions (t/year) | 0.96 | DFEE | 45.82 | TFEE | 51.41 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 10.87 | | |

| | | | |
|------------------|--|-------------|-----------|
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | Assessor ID | R034-0001 |
|------------------|--|-------------|-----------|

| | |
|--------|--|
| Client | |
|--------|--|

ASSESSMENT NOTES - Last time updated on: 17.11.2021

Celotex and ISOVER are separate legal entities to Darren Evans Assessments. Darren Evans Assessments provides the warranty and assumes responsibility for the Energy Assessments Service offered under a commercial agreement with Celotex and ISOVER

PREDICTED ENERGY ASSESSMENT



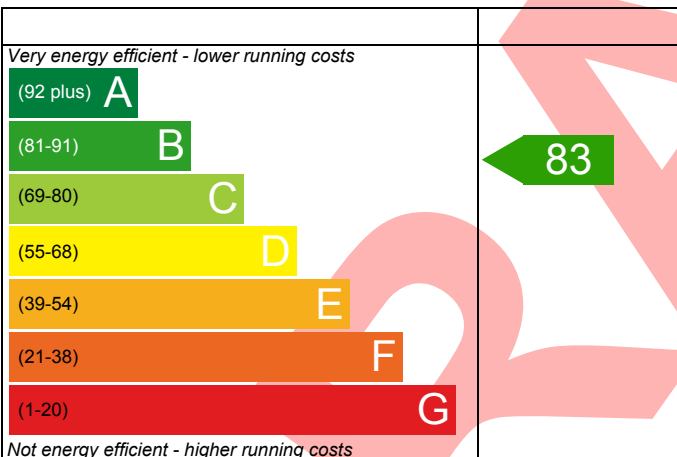
2 bed,
1 bath

Dwelling type: House, End-Terrace
Date of assessment: 17/11/2021
Produced by: Michael Brogden
Total floor area: 57.08 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.

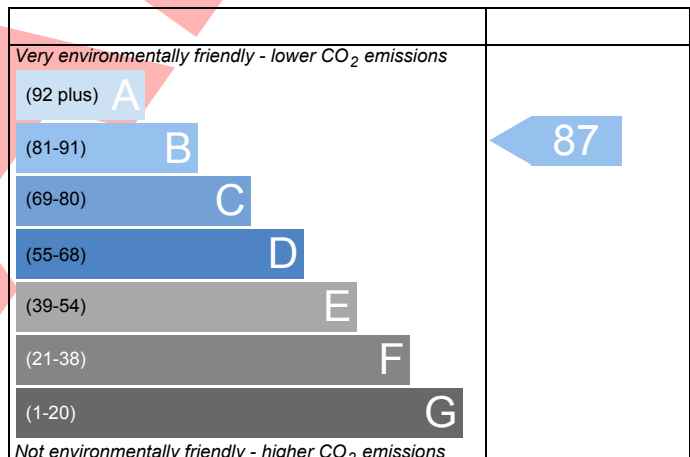
Energy Efficiency Rating



England EU Directive 2002/91/EC

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO₂) Rating



England EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

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SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

| | |
|-----------------------|--------------------|
| Orientation | North West |
| Property Tenure | Unknown |
| Transaction Type | New dwelling |
| Terrain Type | Urban |
| 1.0 Property Type | House, End-Terrace |
| 2.0 Number of Storeys | 2 |
| 3.0 Date Built | 2021 |
| 4.0 Sheltered Sides | 2 |
| 5.0 Sunlight/Shade | Average or unknown |

6.0 Measurements

| | Heat Loss Perimeter | Internal Floor Area | Average Storey Height |
|---------------|---------------------|----------------------|-----------------------|
| Ground Floor: | 15.13 m | 28.54 m ² | 2.31 m |
| 1st Storey: | 15.13 m | 28.54 m ² | 2.56 m |

| | | |
|-----------------|-------|----------------|
| 7.0 Living Area | 17.91 | m ² |
|-----------------|-------|----------------|

| | | |
|----------------------------|--------------------------|---------------------|
| 8.0 Thermal Mass Parameter | Simple calculation - Low | |
| Thermal Mass | 100.00 | kJ/m ² K |

9.0 External Walls

| Description | Type | U-Value (W/m ² K) | Gross Area (m ²) | Nett Area (m ²) |
|-----------------|-------------|------------------------------|------------------------------|-----------------------------|
| External Wall 1 | Cavity Wall | 0.27 | 73.70 | 62.32 |

9.1 Party Walls

| Description | Type | Construction | U-Value (W/m ² K) | Area (m ²) |
|--------------|---------------------------------|--------------|------------------------------|------------------------|
| Party Wall 1 | Filled Cavity with Edge Sealing | | 0.00 | 34.80 |

10.0 External Roofs

| Description | Type | U-Value (W/m ² K) | Gross Area (m ²) | Nett Area (m ²) |
|-----------------|---------------------|------------------------------|------------------------------|-----------------------------|
| External Roof 1 | External Plane Roof | 0.10 | 28.54 | 28.54 |

10.2 Internal Ceilings

| Description | Construction | Area (m ²) |
|-------------|--------------|------------------------|
|-------------|--------------|------------------------|

11.0 Heat Loss Floors

SUMMARY FOR INPUT DATA

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| Description | Type | Construction | U-Value (W/m²K) | Area (m²) |
|-------------------|----------------------|--------------|-----------------|-----------|
| Heat Loss Floor 1 | Ground Floor - Solid | | 0.15 | 28.54 |

11.2 Internal Floors

| Description | Construction | Area (m²) |
|-------------|--------------|-----------|
| | | |

12.0 Opening Types

| Description | Data Source | Type | Glazing | Glazing Gap | Argon Filled | G-value | Frame Type | Frame Factor | U Value (W/m²K) |
|------------------------|--------------|------------|---------------|-------------|--------------|---------|------------|--------------|-----------------|
| French Door | Manufacturer | Window | Double glazed | | | 0.71 | | 0.70 | 1.41 |
| Window | Manufacturer | Window | Double glazed | | | 0.71 | | 0.70 | 1.41 |
| Solid door tall window | Manufacturer | Solid Door | | | | | | | 1.20 |

13.0 Openings

| Name | Opening Type | Location | Orientation | Curtain Type | Overhang Ratio | Wide Overhang | Width (m) | Height (m) | Count | Area (m²) | Curtain Closed |
|------------------|--------------|---------------------|-------------|---------------------------------------|----------------|---------------|-----------|------------|-------|-----------|----------------|
| Front door | Solid Door | [1] External Wall 1 | North West | | | | | | | 1.93 | |
| front windows | Window | [1] External Wall 1 | North West | Dark-coloured curtain or roller blind | 0.00 | | | | | 3.31 | 100 |
| rear french door | Window | [1] External Wall 1 | South East | Dark-coloured curtain or roller blind | 0.00 | | | | | 2.94 | 100 |
| rear windows | Window | [1] External Wall 1 | South East | Dark-coloured curtain or roller blind | 0.00 | | | | | 3.20 | 100 |

14.0 Conservatory

15.0 Draught Proofing

 %

16.0 Draught Lobby

17.0 Thermal Bridging

17.1 List of Bridges

| Source Type | Bridge Type | Length | Psi | Imported | Reference: |
|------------------------|--|--------|-------|----------|------------------------------|
| Independently assessed | E2 Other lintels (including other steel lintels) | 7.00 | 0.211 | No | H+H LN01 - EW01 |
| Independently assessed | E3 Sill | 3.68 | 0.019 | No | APA PF-WD-03 |
| Independently assessed | E4 Jamb | 15.60 | 0.020 | No | APA PF-WD-04 |
| Independently assessed | E5 Ground floor (normal) | 15.13 | 0.044 | No | GF02 - EW01 |
| Independently assessed | E6 Intermediate floor within a dwelling | 15.13 | 0.001 | No | APA PF-IF-01 |
| Table K1 - Approved | E10 Eaves (insulation at ceiling level) | 7.99 | 0.060 | No | |
| Independently assessed | E12 Gable (insulation at ceiling level) | 7.15 | 0.047 | No | APA PF-RG-01 |
| Independently assessed | E16 Corner (normal) | 9.74 | 0.047 | No | H+H CN01-EW01 |
| Table K1 - Approved | E18 Party wall between dwellings | 9.74 | 0.060 | No | |
| Independently assessed | P1 Party wall - Ground floor | 7.15 | 0.053 | No | PW01 - EW01 |
| Table K1 - Default | P2 Party wall - Intermediate floor within a dwelling | 7.15 | 0.000 | No | |
| Independently assessed | P4 Party wall - Roof (insulation at ceiling level) | 7.15 | 0.036 | No | Barratt Confidential Bespoke |

Y-value

 W/m²K

18.0 Pressure Testing

Designed AP₅₀

 m³/(h.m²) @ 50 Pa

SUMMARY FOR INPUT DATA

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Property Tested ?
 As Built AP₅₀ m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather
 Cross ventilation possible
 Night Ventilation
 Air change rate

Mechanical Ventilation

Mechanical Ventilation System Present

20.0 Fans, Open Fireplaces, Flues

| | MHS | SHS | Other | Total |
|------------------------------|-----|-----|-------|-------|
| Number of Chimneys | 0 | | 0 | 0 |
| Number of open flues | 0 | | 0 | 0 |
| Number of intermittent fans | | | | 4 |
| Number of passive vents | | | | 0 |
| Number of flueless gas fires | | | | 0 |

21.0 Fixed Cooling System

22.0 Lighting

Internal

Total number of light fittings
 Total number of L.E.L. fittings
 Percentage of L.E.L. fittings %

External

External lights fitted

23.0 Electricity Tariff

24.0 Main Heating 1

Percentage of Heat %
 Database Ref. No.
 Fuel Type
 Main Heating
 SAP Code
 In Winter
 In Summer
 Controls
 PCDF Controls
 Delayed Start Stat
 Sap Code
 Flue Type
 Fan Assisted Flue
 Is MHS Pumped
 Heat Emitter
 Flow Temperature
 Combi boiler type
 Combi keep hot type

25.0 Main Heating 2

SUMMARY FOR INPUT DATA

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| | |
|--|-------------------------|
| Community Heating | None |
| 28.0 Water Heating | HWP From main heating 1 |
| Water Heating | Main Heating 1 |
| Flue Gas Heat Recovery System | No |
| Waste Water Heat Recovery Instantaneous System 1 | No |
| Waste Water Heat Recovery Instantaneous System 2 | No |
| Waste Water Heat Recovery Storage System | No |
| Solar Panel | No |
| Water use <= 125 litres/person/day | Yes |
| SAP Code | 901 |
| 29.0 Hot Water Cylinder | None |

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

| | Typical Cost | Typical savings per year | Ratings after improvement | |
|------------------------------------|-----------------|--------------------------|---------------------------|----------------------|
| | | | SAP rating | Environmental Impact |
| Solar water heating | £4,000 - £6,000 | £23 | B 84 | |
| | Typical Cost | Typical savings per year | Ratings after improvement | |
| | | | SAP rating | Environmental Impact |
| Solar photovoltaic panels, 2.5 kWp | £3,500 - £5,500 | £349 | A 97 | |

BASIC COMPLIANCE REPORT

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SUMMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

| | | | |
|---|------------------|-----------------------------------|------|
| Fuel for main heating | Mains gas | | |
| Fuel factor | 1.00 (mains gas) | | |
| Target Carbon Dioxide Emission Rate (TER) | 19.83 | kgCO ₂ /m ² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 18.75 | kgCO ₂ /m ² | Pass |
| | -1.08 (-5.4%) | kgCO ₂ /m ² | |

1b TFEE and DFEE

| | | | |
|--|---------------|------------------------|------|
| Target Fabric Energy Efficiency (TFEE) | 51.41 | kWh/m ² /yr | |
| Dwelling Fabric Energy Efficiency (DFEE) | 45.82 | kWh/m ² /yr | |
| | -5.6 (-10.9%) | kWh/m ² /yr | Pass |

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

| Element | Average | Highest | |
|---------------|------------------|------------------|------|
| External wall | 0.27 (max. 0.30) | 0.27 (max. 0.70) | Pass |
| Party wall | 0.00 (max. 0.20) | - | Pass |
| Floor | 0.15 (max. 0.25) | 0.15 (max. 0.70) | Pass |
| Roof | 0.10 (max. 0.20) | 0.10 (max. 0.35) | Pass |
| Openings | 1.37 (max. 2.00) | 1.41 (max. 3.30) | Pass |

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 | Pass |

Limiting System Efficiencies

4 Heating efficiency

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Designed)



Main heating system

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

Pass

Secondary heating system

None

5 Cylinder insulation

Hot water storage

No cylinder

6 Controls

Space heating controls

Time and temperature zone control

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100 %

Minimum

75 %

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Severn Valley)

Slight

Pass

Based on:

Overshading

Average

Windows facing South East

6.14 m², No overhang

Windows facing North West

3.31 m², No overhang

Air change rate

4.00 ach

Blinds/curtains

Dark-coloured curtain or roller blind, closed 100% of daylight hours

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type

U-value

Filled Cavity with Edge Sealing

0.00

W/m²K

Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

5.00 (design value)

Maximum

10.0

Pass

10 Key features

Party wall U-value

0.00

W/m²K

Roof U-value

0.10

W/m²K

Thermal bridging γ -value

0.038

W/m²K

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

FULL SAP CALCULATION PRINTOUT

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FULL SAP CALCULATION PRINTOUT

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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 57 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) 19.83 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.75 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.8 kWh/m²/yrOK

2 Fabric U-values

| Element | Average | Highest | |
|---------------|------------------|------------------|----|
| External wall | 0.27 (max. 0.30) | 0.27 (max. 0.70) | OK |
| Party wall | 0.00 (max. 0.20) | - | OK |
| Floor | 0.15 (max. 0.25) | 0.15 (max. 0.70) | OK |
| Roof | 0.10 (max. 0.20) | 0.10 (max. 0.35) | OK |
| Openings | 1.37 (max. 2.00) | 1.41 (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 database

Ideal LOGIC COMBI ESP1 35

Combi boiler

Efficiency: 89.6% SEDBUK2009

Minimum: 88.0%

OK

Secondary heating system:

None

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

Not applicable

9 Summertime temperature

Overheating risk (Severn Valley): Slight OK

Based on:

Overshading:

Average

Windows facing South East:

6.14 m², No overhang

Windows facing North West:

3.31 m², No overhang

Air change rate:

4.00 ach

Blinds/curtains:

Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.10 W/m²K

Thermal bridging y-value 0.038 W/m²K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) | | | | | | | |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) | | | | | | | |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) | | | | | | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 | | | | | |
|---|-------------|-------------|-------------|---------------|------------------------------|----------------|---------------|-------------|-------------|-------------|-------------|------------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) | | | | | |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) | | | | | |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = 38.8905 | | (33) | | | | | |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 100.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 5.0338 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 43.9243 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 30.7236 | Feb 30.4211 | Mar 30.1246 | Apr 28.7318 | May 28.4713 | Jun 27.2582 | Jul 27.2582 | Aug 27.0336 | Sep 27.7255 | Oct 28.4713 | Nov 28.9984 | Dec 29.5495 (38) |
| Heat transfer coeff | 74.6478 | 74.3453 | 74.0488 | 72.6561 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.6498 | 72.3955 | 72.9227 | 73.4738 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.6549 (39) |
| HLP | Jan 1.3078 | Feb 1.3025 | Mar 1.2973 | Apr 1.2729 | May 1.2683 | Jun 1.2471 | Jul 1.2471 | Aug 1.2431 | Sep 1.2553 | Oct 1.2683 | Nov 1.2776 | Dec 1.2872 (40) |
| HLP (average) | | | | | | | | | | | | 1.2729 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Water storage loss: | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | (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 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 15.2944 | 13.5843 | 11.0475 | 8.3637 | 6.2520 | 5.2782 | 5.7032 | 7.4133 | 9.9501 | 12.6339 | 14.7457 | 15.7195 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.5274 | 167.2450 | 162.9166 | 153.7018 | 142.0699 | 131.1375 | 123.8340 | 122.1163 | 126.4448 | 135.6595 | 147.2915 | 158.2238 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 297.8004 | 295.9706 | 285.2937 | 268.2150 | 251.1076 | 234.4667 | 223.5660 | 228.7143 | 237.4131 | 254.6729 | 274.4707 | 289.0954 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|------------|--------------------------------|------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 37.2574 | (77) | | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 40.5522 | (77) | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7700 | 12.8629 | (81) | | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | (83) |
| Total gains | 388.4729 | 454.6920 | 513.8119 | 570.3821 | 606.9224 | 595.3456 | 568.3135 | 532.2706 | 491.2526 | 433.1537 | 383.8535 | 366.1887 | (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) | 21.2405 | 21.3269 | 21.4123 | 21.8227 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.1293 | 21.9013 | 21.7430 | 21.5799 | (85) |
| alpha | 2.4160 | 2.4218 | 2.4275 | 2.4548 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4753 | 2.4601 | 2.4495 | 2.4387 | |
| util living area | 0.9581 | 0.9383 | 0.9053 | 0.8435 | 0.7469 | 0.6129 | 0.4868 | 0.5275 | 0.7145 | 0.8721 | 0.9403 | 0.9631 | (86) |
| MIT | 18.4049 | 18.7099 | 19.1877 | 19.8050 | 20.3386 | 20.7253 | 20.8893 | 20.8616 | 20.5670 | 19.8720 | 19.0436 | 18.3656 | (87) |
| Th 2 | 19.8347 | 19.8389 | 19.8430 | 19.8621 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8761 | 19.8657 | 19.8585 | 19.8509 | (88) |
| util rest of house | 0.9515 | 0.9287 | 0.8902 | 0.8173 | 0.7016 | 0.5386 | 0.3833 | 0.4250 | 0.6490 | 0.8451 | 0.9295 | 0.9573 | (89) |
| MIT 2 | 16.4009 | 16.8416 | 17.5284 | 18.4098 | 19.1375 | 19.6369 | 19.8123 | 19.7920 | 19.4558 | 18.5237 | 17.3403 | 16.3527 | (90) |
| Living area fraction | 17.0297 | 17.4278 | 18.0491 | 18.8476 | 19.5144 | 19.9784 | 20.1502 | 20.1276 | 19.8044 | 18.9468 | 17.8747 | 16.9843 | (91) |
| MIT | 17.0297 | 17.4278 | 18.0491 | 18.8476 | 19.5144 | 19.9784 | 20.1502 | 20.1276 | 19.8044 | 18.9468 | 17.8747 | 16.9843 | (92) |
| Temperature adjustment | 16.8797 | 17.2778 | 17.8991 | 18.6976 | 19.3644 | 19.8284 | 20.0002 | 19.9776 | 19.6544 | 18.7968 | 17.7247 | 16.8343 | (93) |
| adjusted MIT | 16.8797 | 17.2778 | 17.8991 | 18.6976 | 19.3644 | 19.8284 | 20.0002 | 19.9776 | 19.6544 | 18.7968 | 17.7247 | 16.8343 | (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Useful gains | 360.0807 | 408.8737 | 440.1163 | 447.3650 | 411.7789 | 318.2734 | 224.4804 | 231.1216 | 311.5103 | 351.8853 | 345.8109 | 342.2682 | (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 | 939.0464 | 920.2346 | 844.0877 | 711.8521 | 554.8671 | 372.1704 | 242.0375 | 253.8569 | 397.9749 | 593.4120 | 774.7845 | 928.2879 | (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 | 430.7504 | 343.6345 | 300.5547 | 190.4307 | 106.4576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.6959 | 308.8610 | 435.9987 | (98) |
| Space heating | | | | | | | | | | | | 2296.3835 | (98) |
| Space heating per m2 | | | | | | | | | | | | 40.2310 | (99) |

8c. Space cooling requirement

Not applicable

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Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

| | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 2537.4403 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 430.7504 | 343.6345 | 300.5547 | 190.4307 | 106.4576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.6959 | 308.8610 | 435.9987 | (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | 475.9673 | 379.7067 | 332.1046 | 210.4207 | 117.6328 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.5590 | 341.2828 | 481.7665 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) |
| Efficiency of water heater (217)m | 89.6792 | 89.6199 | 89.5057 | 89.2663 | 88.8337 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.1934 | 89.5338 | 87.3000 | (216) |
| Fuel for water heating, kWh/month | 159.8472 | 140.3256 | 146.0227 | 129.1170 | 125.5919 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.1095 | 143.9416 | 155.2446 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1589.3220 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 2537.4403 (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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4471.8661 (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 | 2537.4403 | 0.2160 | 548.0871 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1589.3220 | 0.2160 | 343.2936 (264) |
| Space and water heating | | | 891.3807 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total CO2, kg/year | | | 1070.4895 (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 18.7500 (273) |

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

| | TFA | N | EF |
|---|---------|--------|-------------|
| DER | | | 18.7500 ZC1 |
| Total Floor Area | 57.0800 | | |
| Assumed number of occupants | 1.8980 | | |
| CO2 emission factor in Table 12 for electricity displaced from grid | | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | | 17.1843 ZC2 |
| CO2 emissions from cooking, equation (L16) | | | 2.8828 ZC3 |
| Total CO2 emissions | | | 38.8171 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 | | | 38.8171 ZC8 |

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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 (m ²) | Storey height (m) | Volume (m ³) |
|--|------------------------|-------------------|--|
| Ground floor | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m ³ per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|-------------------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) | | | | 20.0000 / (5) = | 0.1439 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | | 0.3939 (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) = | | 0.3348 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| Effective ac | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (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 | | | | | |
|---|----------------------|-------------------------|------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|-------------|-------------|-------------|-------------|------------------|
| TER Opaque door | | | 1.9300 | 1.0000 | 1.9300 | | (26) | | | | | |
| TER Opening Type (Uw = 1.40) | | | 9.4500 | 1.3258 | 12.5284 | | (27) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1300 | 3.7102 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.1800 | 11.2176 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1300 | 3.7102 | | (30) | | | | | |
| Total net area of external elements Aum(A, m ²) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = 33.0964 | | (33) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K | | | | | | | 250.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 7.5342 (36) | | | | | |
| Total fabric heat loss | | | | | | | (33) + (36) = 40.6306 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 27.1125 | Feb 26.9502 | Mar 26.7911 | Apr 26.0440 | May 25.9042 | Jun 25.2535 | Jul 25.2535 | Aug 25.1329 | Sep 25.5041 | Oct 25.9042 | Nov 26.1870 | Dec 26.4826 (38) |
| Heat transfer coeff | 67.7431 | 67.5808 | 67.4217 | 66.6746 | 66.5348 | 65.8841 | 65.8841 | 65.7636 | 66.1347 | 66.5348 | 66.8176 | 67.1132 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 66.6739 (39) |
| HLP | Jan 1.1868 | Feb 1.1840 | Mar 1.1812 | Apr 1.1681 | May 1.1656 | Jun 1.1542 | Jul 1.1542 | Aug 1.1521 | Sep 1.1586 | Oct 1.1656 | Nov 1.1706 | Dec 1.1758 (40) |
| HLP (average) | | | | | | | | | | | | 1.1681 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss: | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | |

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | | | | | | | | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Total heat required for water heating calculated for each month | 44.4387 | 38.6786 | 41.2068 | 38.3137 | 37.9749 | 35.1861 | 36.3589 | 37.9749 | 38.3137 | 41.2068 | 41.4414 | 44.4387 | 61 | | | | | | | | | |
| Solar input | 173.7612 | 151.7849 | 157.9223 | 140.0692 | 135.6117 | 119.4392 | 114.4318 | 127.5647 | 128.9735 | 146.8620 | 156.7723 | 169.6806 | 62 | | | | | | | | | |
| Output from w/h | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 63 | | | | | | | | | |
| Heat gains from water heating, kWh/month | 173.7612 | 151.7849 | 157.9223 | 140.0692 | 135.6117 | 119.4392 | 114.4318 | 127.5647 | 128.9735 | 146.8620 | 156.7723 | 169.6806 | 64 | | | | | | | | | |
| | 54.1094 | 47.2775 | 49.1096 | 43.4121 | 41.9579 | 36.8107 | 35.0490 | 39.2823 | 39.7228 | 45.4321 | 48.7079 | 52.7526 | 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) |
| (66)m | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 66 |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 15.2944 | 13.5843 | 11.0475 | 8.3637 | 6.2520 | 5.2782 | 5.7032 | 7.4133 | 9.9501 | 12.6339 | 14.7457 | 15.7195 | 67 |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.5274 | 167.2450 | 162.9166 | 153.7018 | 142.0699 | 131.1375 | 123.8340 | 122.1163 | 126.4448 | 135.6595 | 147.2915 | 158.2238 | 68 |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | 71 |
| Water heating gains (Table 5) | 72.7277 | 70.3534 | 66.0075 | 60.2946 | 56.3951 | 51.1259 | 47.1088 | 52.7988 | 55.1706 | 61.0646 | 67.6498 | 70.9041 | 72 |
| Total internal gains | 308.0193 | 305.6526 | 294.4415 | 276.8300 | 259.1868 | 242.0115 | 231.1159 | 236.7983 | 246.0353 | 263.8279 | 284.1568 | 299.3172 | 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 | | | | | | | | |
| Southeast | 6.1400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 69.0423 | 77 | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 11.4136 | 81 | | | | | | |
| Solar gains | 80.4559 | 140.8373 | 202.7696 | 268.1201 | 315.7230 | 320.2165 | 305.9027 | 269.3528 | 225.2379 | 158.3703 | 97.0580 | 68.4067 | 83 |
| Total gains | 388.4752 | 446.4899 | 497.2111 | 544.9501 | 574.9098 | 562.2280 | 537.0187 | 506.1511 | 471.2732 | 422.1982 | 381.2148 | 367.7239 | 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, nil,m (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
| tau | 58.5136 | 58.6541 | 58.7925 | 59.4513 | 59.5762 | 60.1646 | 60.1646 | 60.2749 | 59.9366 | 59.5762 | 59.3240 | 59.0627 | | | |
| alpha | 4.9009 | 4.9103 | 4.9195 | 4.9634 | 4.9717 | 5.0110 | 5.0110 | 5.0183 | 4.9958 | 4.9717 | 4.9549 | 4.9375 | | | |
| util living area | 0.9965 | 0.9925 | 0.9820 | 0.9488 | 0.8616 | 0.6961 | 0.5282 | 0.5786 | 0.8195 | 0.9647 | 0.9928 | 0.9973 | 86 | | |
| MIT | 19.7837 | 19.9455 | 20.1994 | 20.5249 | 20.7975 | 20.9502 | 20.9898 | 20.9842 | 20.8848 | 20.5330 | 20.0980 | 19.7541 | 87 | | |
| Th 2 | 19.9306 | 19.9328 | 19.9351 | 19.9456 | 19.9476 | 19.9568 | 19.9568 | 19.9585 | 19.9532 | 19.9476 | 19.9436 | 19.9394 | 88 | | |
| util rest of house | 0.9953 | 0.9900 | 0.9757 | 0.9301 | 0.8126 | 0.6036 | 0.4090 | 0.4571 | 0.7421 | 0.9481 | 0.9899 | 0.9964 | 89 | | |
| MIT 2 | 18.3215 | 18.5584 | 18.9270 | 19.3941 | 19.7515 | 19.9241 | 19.9531 | 19.9521 | 19.8634 | 19.4149 | 18.7893 | 18.2846 | 90 | | |
| Living area fraction | | | | | | | | | | | | | fLA = Living area / (4) = | 0.3138 | 91 |
| MIT | 18.7803 | 18.9936 | 19.3263 | 19.7489 | 20.0797 | 20.2461 | 20.2784 | 20.2759 | 20.1839 | 19.7657 | 19.1999 | 18.7457 | 92 | | |
| Temperature adjustment | | | | | | | | | | | | | 0.0000 | | |
| adjusted MIT | 18.7803 | 18.9936 | 19.3263 | 19.7489 | 20.0797 | 20.2461 | 20.2784 | 20.2759 | 20.1839 | 19.7657 | 19.1999 | 18.7457 | 93 | | |

8. Space heating requirement

| | | | | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|---------|----|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (94) | | |
| Useful gains | 0.9935 | 0.9870 | 0.9710 | 0.9258 | 0.8195 | 0.6308 | 0.4466 | 0.4955 | 0.7612 | 0.9444 | 0.9871 | 0.9950 | 94 | | |
| Ext temp. | 385.9593 | 440.6768 | 482.7819 | 504.5247 | 471.1512 | 354.6517 | 239.8576 | 250.7821 | 358.7470 | 398.7090 | 376.3016 | 365.8707 | 95 | | |
| Heat loss rate W | 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 | | |
| Month fracti | 980.9381 | 952.4557 | 864.7689 | 723.3448 | 557.5427 | 371.9853 | 242.3457 | 254.8955 | 402.3545 | 609.8394 | 808.4869 | 976.2096 | 97 | | |
| Space heating kWh | 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 | 442.6643 | 343.9154 | 284.1983 | 157.5505 | 64.2753 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.0810 | 311.1734 | 454.0922 | 98 | | |
| Space heating per m2 | | | | | | | | | | | | | 2214.9505 | 98 | |
| | | | | | | | | | | | | | (98) / (4) = | 38.8043 | 99 |

8c. Space cooling requirement

Not applicable

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



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | 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 | | | | | | | | | | | | | 2371.4673 (211) |
| Space heating requirement | 442.6643 | 343.9154 | 284.1983 | 157.5505 | 64.2753 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.0810 | 311.1734 | 454.0922 | (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) | 473.9446 | 368.2178 | 304.2809 | 168.6836 | 68.8173 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 168.1810 | 333.1621 | 486.1801 | (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 | 173.7612 | 151.7849 | 157.9223 | 140.0692 | 135.6117 | 119.4392 | 114.4318 | 127.5647 | 128.9735 | 146.8620 | 156.7723 | 169.6806 | (64) |
| Efficiency of water heater (217)m | 87.3046 | 87.0475 | 86.5132 | 85.3478 | 83.2924 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.2207 | 86.7447 | 87.4093 | (216) |
| Fuel for water heating, kWh/month | 199.0286 | 174.3702 | 182.5413 | 164.1157 | 162.8140 | 148.7412 | 142.5054 | 158.8601 | 160.6145 | 172.3313 | 180.7284 | 194.1219 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 2040.7726 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 2371.4673 (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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4757.3437 (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 | 2371.4673 | 0.2160 | 512.2369 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 2040.7726 | 0.2160 | 440.8069 (264) |
| Space and water heating | | | 953.0438 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total CO2, kg/m2/year | | | 1132.1527 (272) |
| Emissions per m2 for space and water heating | | | 16.6966 (272a) |
| Fuel factor (mains gas) | | | 1.0000 |
| Emissions per m2 for lighting | | | 2.4559 (272b) |
| Emissions per m2 for pumps and fans | | | 0.6819 (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (16.6966 * 1.00) + 2.4559 + 0.6819, rounded to 2 d.p. | | | 19.8300 (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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) | | | | 20.0000 / (5) = | 0.1439 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | | 0.3939 (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) = | | 0.3348 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (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 |
|--|----------|-------------|------------|---------------|------------------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = 38.8905 | | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 27.1125 | 26.9502 | 26.7911 | 26.0440 | 25.9042 | 25.2535 | 25.2535 | 25.1329 | 25.5041 | 25.9042 | 26.1870 | 26.4826 (38) |
| Heat transfer coeff | 71.0367 | 70.8744 | 70.7154 | 69.9682 | 69.8285 | 69.1777 | 69.1777 | 69.0572 | 69.4284 | 69.8285 | 70.1112 | 70.4069 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 69.9676 (39) |
| HLP | 1.2445 | 1.2417 | 1.2389 | 1.2258 | 1.2233 | 1.2119 | 1.2119 | 1.2098 | 1.2163 | 1.2233 | 1.2283 | 1.2335 (40) |
| HLP (average) | | | | | | | | | | | | 1.2258 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| 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) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | |
|--|--------|--------|--------|--------|--------|----------|----------|----------|--------------------------|--------|--------|----------------|
| Space cooling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 177.3573 | 215.6057 | 185.4818 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) |
| Cooled fraction | | | | | | | | | FC = cooled area / (4) = | | | 578.4448 (104) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | 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 | 44.3393 | 53.9014 | 46.3705 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) |
| Space cooling per m2 | | | | | | | | | | | | 144.6112 (107) |
| Energy for space heating | | | | | | | | | | | | 2.5335 (108) |
| Energy for space cooling | | | | | | | | | | | | 43.2846 (99) |
| Total | | | | | | | | | | | | 2.5335 (108) |
| Dwelling Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 45.8181 (109) |
| | | | | | | | | | | | | 45.8 (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 (m ²) | Storey height (m) | Volume (m ³) |
|--|------------------------|-------------------|--|
| Ground floor | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m ³ per hour |
|---|--------------|-------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) = | | | | 20.0000 / (5) = | 0.1439 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | 0.3939 (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) = | | 0.3348 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (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 | | | | | |
|---|----------------------|-------------------------|------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|---------|---------|---------|---------|--------------|
| TER Opaque door | | | 1.9300 | 1.0000 | 1.9300 | | (26) | | | | | |
| TER Opening Type (Uw = 1.40) | | | 9.4500 | 1.3258 | 12.5284 | | (27) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1300 | 3.7102 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.1800 | 11.2176 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1300 | 3.7102 | | (30) | | | | | |
| Total net area of external elements Aum(A, m ²) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = 33.0964 | | (33) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K | | | | | | | 250.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 7.5342 (36) | | | | | |
| Total fabric heat loss | | | | | | | (33) + (36) = 40.6306 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | 27.1125 | 26.9502 | 26.7911 | 26.0440 | 25.9042 | 25.2535 | 25.2535 | 25.1329 | 25.5041 | 25.9042 | 26.1870 | 26.4826 (38) |
| Heat transfer coeff | 67.7431 | 67.5808 | 67.4217 | 66.6746 | 66.5348 | 65.8841 | 65.8841 | 65.7636 | 66.1347 | 66.5348 | 66.8176 | 67.1132 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 66.6739 (39) |
| HLP | 1.1868 | 1.1840 | 1.1812 | 1.1681 | 1.1656 | 1.1542 | 1.1542 | 1.1521 | 1.1586 | 1.1656 | 1.1706 | 1.1758 (40) |
| HLP (average) | | | | | | | | | | | | 1.1681 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| 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) |
| Total storage loss | | | | | | | | | | | | |
| If cylinder contains dedicated solar storage | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (56) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| 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 | 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 | 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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) | |
| | 27.4810 | 24.0351 | 24.8021 | 21.6230 | 20.7478 | 17.9038 | 16.5905 | 19.0378 | 19.2652 | 22.4517 | 24.5078 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | 26.6139 | (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 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 15.2944 | 13.5843 | 11.0475 | 8.3637 | 6.2520 | 5.2782 | 5.7032 | 7.4133 | 9.9501 | 12.6339 | 14.7457 | 15.7195 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.5274 | 167.2450 | 162.9166 | 153.7018 | 142.0699 | 131.1375 | 123.8340 | 122.1163 | 126.4448 | 135.6595 | 147.2915 | 158.2238 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 36.9369 | 35.7665 | 33.3361 | 30.0320 | 27.8868 | 24.8664 | 22.2990 | 25.5885 | 26.7572 | 30.1771 | 34.0386 | 35.7714 | (72) |
| Total internal gains | 269.2285 | 268.0657 | 258.7700 | 243.5674 | 227.6785 | 212.7519 | 203.3061 | 206.5880 | 214.6220 | 229.9404 | 247.5456 | 261.1845 | (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 | | | | | | | |
|-------------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|----------|----------|----------|------|
| Southeast | 6.1400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 69.0423 (77) | | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 11.4136 (81) | | | | | | | |
| Solar gains | 80.4559 | 140.8373 | 202.7696 | 268.1201 | 315.7230 | 320.2165 | 305.9027 | 269.3528 | 225.2379 | 158.3703 | 97.0580 | 68.4067 | (83) |
| Total gains | 349.6843 | 408.9030 | 461.5397 | 511.6875 | 543.4016 | 532.9684 | 509.2089 | 475.9408 | 439.8598 | 388.3107 | 344.6036 | 329.5913 | (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) | 58.5136 | 58.6541 | 58.7925 | 59.4513 | 59.5762 | 60.1646 | 60.1646 | 60.2749 | 59.9366 | 59.5762 | 59.3240 | 59.0627 | 21.0000 (85) |
| tau | 4.9009 | 4.9103 | 4.9195 | 4.9634 | 4.9717 | 5.0110 | 5.0110 | 5.0183 | 4.9958 | 4.9717 | 4.9549 | 4.9375 | |
| alpha | 0.9978 | 0.9949 | 0.9867 | 0.9591 | 0.8817 | 0.7235 | 0.5542 | 0.6101 | 0.8481 | 0.9744 | 0.9954 | 0.9984 | (86) |
| util living area | 19.7213 | 19.8860 | 20.1456 | 20.4818 | 20.7708 | 20.9407 | 20.9874 | 20.9800 | 20.8632 | 20.4855 | 20.0398 | 19.6924 | (87) |
| MIT | 19.9306 | 19.9328 | 19.9351 | 19.9456 | 19.9476 | 19.9568 | 19.9568 | 19.9585 | 19.9532 | 19.9476 | 19.9436 | 19.9394 | (88) |
| Th 2 | 0.9971 | 0.9931 | 0.9819 | 0.9435 | 0.8366 | 0.6312 | 0.4305 | 0.4845 | 0.7759 | 0.9616 | 0.9935 | 0.9978 | (89) |
| util rest of house | 18.7698 | 18.9356 | 19.1945 | 19.5296 | 19.7931 | 19.9297 | 19.9536 | 19.9529 | 19.8780 | 19.5398 | 19.0981 | 18.7481 | (90) |
| MIT 2 | 19.0684 | 19.2338 | 19.4930 | 19.8283 | 20.0999 | 20.2469 | 20.2780 | 20.2752 | 20.1871 | 19.8365 | 19.3936 | 19.0444 | (91) |
| Living area fraction | 19.0684 | 19.2338 | 19.4930 | 19.8283 | 20.0999 | 20.2469 | 20.2780 | 20.2752 | 20.1871 | 19.8365 | 19.3936 | 19.0444 | (92) |
| MIT | 19.0684 | 19.2338 | 19.4930 | 19.8283 | 20.0999 | 20.2469 | 20.2780 | 20.2752 | 20.1871 | 19.8365 | 19.3936 | 19.0444 | (93) |
| Temperature adjustment | | | | | | | | | | | | | 0.0000 |
| adjusted MIT | 19.0684 | 19.2338 | 19.4930 | 19.8283 | 20.0999 | 20.2469 | 20.2780 | 20.2752 | 20.1871 | 19.8365 | 19.3936 | 19.0444 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation | 0.9962 | 0.9916 | 0.9793 | 0.9414 | 0.8440 | 0.6587 | 0.4698 | 0.5244 | 0.7943 | 0.9598 | 0.9921 | 0.9972 | (94) |
| Useful gains | 348.3648 | 405.4602 | 451.9899 | 481.6833 | 458.6414 | 351.0794 | 239.2098 | 249.5697 | 349.3654 | 372.7196 | 341.8851 | 328.6534 | (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 | 1000.4538 | 968.6912 | 876.0081 | 728.6431 | 558.8858 | 372.0414 | 242.3199 | 254.8442 | 402.5688 | 614.5503 | 821.4257 | 996.2560 | (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 | 485.1542 | 378.4912 | 315.4696 | 177.8110 | 74.5818 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.9220 | 345.2692 | 496.6964 | (98) |
| Space heating | | | | | | | | | | | | 2453.3954 | (98) |
| Space heating per m2 | | | | | | | | | | | | 42.9817 | (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 | 619.3102 | 487.5421 | 499.8030 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.8774 | 0.9334 | 0.9129 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 543.4006 | 455.0792 | 456.2527 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 694.3142 | 665.1784 | 627.4586 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Month fracti | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103a) |
| Space cooling kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 108.6578 | 156.3139 | 127.3772 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (104) |
| Space cooling | | | | | | | | | | | | 392.3488 | (104) |
| Cooled fraction | | | | | | | | | | | | 1.0000 | (105) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | |
|--|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|--------|---------------|
| Intermittency factor (Table 10b) | 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 | 27.1644 | 39.0785 | 31.8443 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling | | | | | | | | | | | | 98.0872 (107) |
| Space cooling per m2 | | | | | | | | | | | | 1.7184 (108) |
| Energy for space heating | | | | | | | | | | | | 42.9817 (99) |
| Energy for space cooling | | | | | | | | | | | | 1.7184 (108) |
| Total | | | | | | | | | | | | 44.7001 (109) |
| Target Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 51.4 (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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 74.0488 | 73.1952 | 73.4738 | 72.3955 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.1825 | 72.3955 | 72.3955 | 73.1952 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.3334 (39) |
| HLP | 1.2973 | 1.2823 | 1.2872 | 1.2683 | 1.2683 | 1.2471 | 1.2471 | 1.2431 | 1.2471 | 1.2683 | 1.2683 | 1.2823 (40) |
| HLP (average) | | | | | | | | | | | | 1.2672 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) | |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | (57) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (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 | 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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (64) |
| RHI water heating demand | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (73) |

6. Solar gains

| | | | | | | | | | | | | |
|-------------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| [Jan] | Area m2 | Solar flux Table 6a W/m2 | Specific data g or Table 6b | Specific data FF or Table 6c | Access factor Table 6d | Gains W | | | | | | |
| Southeast | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 (77) | | | | | | |
| Southeast | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 (77) | | | | | | |
| Northwest | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 (81) | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 (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 | 21.4123 | 21.6620 | 21.5799 | 21.9013 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.2745 | 21.9013 | 21.9013 | 21.6620 | |
| alpha | 2.4275 | 2.4441 | 2.4387 | 2.4601 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4850 | 2.4601 | 2.4601 | 2.4441 | |
| util living area | 0.9132 | 0.8908 | 0.8453 | 0.7660 | 0.6598 | 0.5013 | 0.4042 | 0.4195 | 0.6040 | 0.7883 | 0.9224 | 0.9215 | (86) |
| MIT | 18.9286 | 19.1601 | 19.5901 | 20.1123 | 20.5381 | 20.8384 | 20.9292 | 20.9234 | 20.7263 | 20.1907 | 19.2822 | 18.8884 | (87) |
| Th 2 | 19.8430 | 19.8547 | 19.8509 | 19.8657 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8825 | 19.8657 | 19.8657 | 19.8547 | (88) |
| util rest of house | 0.9006 | 0.8754 | 0.8231 | 0.7320 | 0.6072 | 0.4260 | 0.3103 | 0.3234 | 0.5322 | 0.7494 | 0.9083 | 0.9100 | (89) |
| MIT 2 | 17.1530 | 17.4870 | 18.0911 | 18.8193 | 19.3812 | 19.7497 | 19.8404 | 19.8397 | 19.6344 | 18.9447 | 17.6854 | 17.1035 | (90) |
| Living area fraction | 17.7101 | 18.0120 | 18.5615 | 19.2250 | 19.7442 | 20.0913 | 20.1821 | 20.1798 | 19.9770 | 19.3357 | 18.1864 | 17.6636 | (92) |
| Temperature adjustment | 17.5601 | 17.8620 | 18.4115 | 19.0750 | 19.5942 | 19.9413 | 20.0321 | 20.0298 | 19.8270 | 19.1857 | 18.0364 | -0.1500 | |
| adjusted MIT | 17.5601 | 17.8620 | 18.4115 | 19.0750 | 19.5942 | 19.9413 | 20.0321 | 20.0298 | 19.8270 | 19.1857 | 18.0364 | 17.5136 | (93) |

8. Space heating requirement

| | | | | | | | | | | | | | |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Useful gains | 471.7935 | 504.5846 | 519.6048 | 507.5883 | 434.7525 | 320.7479 | 226.2617 | 224.4397 | 331.8682 | 409.7730 | 365.3992 | 450.6338 | (94) |
| Ext temp. | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 | (96) |
| Heat loss rate W | 937.4667 | 919.4758 | 838.4438 | 707.6681 | 535.3076 | 351.7370 | 237.1839 | 236.2722 | 386.3094 | 585.3657 | 741.0726 | 923.2534 | (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 | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 | (98) |
| Space heating | | | | | | | | | | | | 1834.1093 | (98) |
| RHI space heating demand | | | | | | | | | | | | 1834 | (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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) | | | | | | | |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) | | | | | | | |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) | | | | | | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 | | | | | |
|---|-------------|-------------|-------------|---------------|----------------------|----------------|---------------|-------------|-------------|-------------|-------------|------------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) | | | | | |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) | | | | | |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) | | | | | |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 100.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 5.0338 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 43.9243 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 30.7236 | Feb 30.4211 | Mar 30.1246 | Apr 28.7318 | May 28.4713 | Jun 27.2582 | Jul 27.2582 | Aug 27.0336 | Sep 27.7255 | Oct 28.4713 | Nov 28.9984 | Dec 29.5495 (38) |
| Heat transfer coeff | 74.6478 | 74.3453 | 74.0488 | 72.6561 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.6498 | 72.3955 | 72.9227 | 73.4738 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.6549 (39) |
| HLP | Jan 1.3078 | Feb 1.3025 | Mar 1.2973 | Apr 1.2729 | May 1.2683 | Jun 1.2471 | Jul 1.2471 | Aug 1.2431 | Sep 1.2553 | Oct 1.2683 | Nov 1.2776 | Dec 1.2872 (40) |
| HLP (average) | | | | | | | | | | | | 1.2729 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Water storage loss: | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|------------------------|--|------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 37.2574 | (77) | | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 40.5522 | (77) | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7700 | 12.8629 | (81) | | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | (83) |
| Total gains | 527.7187 | 592.2188 | 645.4015 | 693.4074 | 721.0509 | 702.6288 | 672.6371 | 638.3133 | 603.2324 | 553.6979 | 513.2945 | 502.4750 | (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) | 0.9237 | 0.8990 | 0.8595 | 0.7891 | 0.6862 | 0.5487 | 0.4256 | 0.4593 | 0.6385 | 0.8103 | 0.8969 | 0.9306 | (86) |
| MIT | 18.7470 | 19.0243 | 19.4545 | 20.0035 | 20.4634 | 20.7879 | 20.9185 | 20.8992 | 20.6702 | 20.0851 | 19.3417 | 18.7090 | (87) |
| Th 2 | 19.8347 | 19.8389 | 19.8430 | 19.8621 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8761 | 19.8657 | 19.8585 | 19.8509 | (88) |
| util rest of house | 0.9127 | 0.8848 | 0.8393 | 0.7579 | 0.6376 | 0.4758 | 0.3306 | 0.3642 | 0.5700 | 0.7755 | 0.8802 | 0.9206 | (89) |
| MIT 2 | 16.8879 | 17.2845 | 17.8962 | 18.6710 | 19.2869 | 19.6977 | 19.8324 | 19.8197 | 19.5663 | 18.8027 | 17.7573 | 16.8429 | (90) |
| Living area fraction | 17.4712 | 17.8304 | 18.3852 | 19.0891 | 19.6561 | 20.0397 | 20.1732 | 20.1585 | 19.9127 | 19.2051 | 18.2544 | 17.4285 | (92) |
| MIT | 17.4712 | 17.8304 | 18.3852 | 19.0891 | 19.6561 | 20.0397 | 20.1732 | 20.1585 | 19.9127 | 19.2051 | 18.2544 | 17.4285 | (92) |
| Temperature adjustment | 17.3212 | 17.6804 | 18.2352 | 18.9391 | 19.5061 | 19.8897 | 20.0232 | 20.0085 | 19.7627 | 19.0551 | 18.1044 | 17.2785 | (93) |
| adjusted MIT | 17.3212 | 17.6804 | 18.2352 | 18.9391 | 19.5061 | 19.8897 | 20.0232 | 20.0085 | 19.7627 | 19.0551 | 18.1044 | 17.2785 | (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Useful gains | 464.7593 | 503.6492 | 519.2133 | 505.0089 | 447.3155 | 334.6927 | 230.8343 | 239.5943 | 339.1938 | 412.8948 | 434.5250 | 447.2053 | (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 | 972.0055 | 950.1657 | 868.9748 | 729.3997 | 565.1244 | 376.5362 | 243.6704 | 256.0485 | 405.7301 | 612.1125 | 802.4717 | 960.9235 | (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 | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 | (98) |
| Space heating | | | | | | | | | | | | 1982.2300 | (98) |
| Space heating per m ² | | | | | | | | | | | | 34.7272 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

| | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 2190.3094 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 | (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | 417.0068 | 331.5570 | 287.5387 | 178.5209 | 96.8507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 163.7768 | 292.7311 | 422.3275 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) |
| Efficiency of water heater (217)m | 89.5959 | 89.5308 | 89.4043 | 89.1396 | 88.6796 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.0423 | 89.4272 | 87.3000 | (216) |
| Fuel for water heating, kWh/month | 159.9958 | 140.4653 | 146.1882 | 129.3006 | 125.8102 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.3370 | 144.1131 | 155.3854 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1590.7175 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | 2190.3094 (211) |
| Space heating fuel - main system | | | | | | | | | | | | | 0.0000 (215) |
| Space heating fuel - secondary | | | | | | | | | | | | | |
| 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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4126.1307 (238) |

10a. Fuel costs - using Table 12 prices

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|-------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 2190.3094 | 3.4800 | 76.2228 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 1590.7175 | 3.4800 | 55.3570 (247) |
| Pumps and fans for heating | 75.0000 | 13.1900 | 9.8925 (249) |
| Energy for lighting | 270.1038 | 13.1900 | 35.6267 (250) |
| Additional standing charges | | | 120.0000 (251) |
| Total energy cost | | | 297.0989 (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|---|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | $[(255) \times (256)] / [(4) + 45.0] =$ | 1.2224 (257) |
| SAP value | | 82.9477 |
| SAP rating (Section 12) | | 83 (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 | 2190.3094 | 0.2160 | 473.1068 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1590.7175 | 0.2160 | 343.5950 (264) |
| Space and water heating | | | 816.7018 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total kg/year | | | 995.8107 (272) |
| CO2 emissions per m2 | | | 17.4500 (273) |
| EI value | | | 86.9280 |
| EI rating | | | 87 (274) |
| EI band | | | B |

Calculation of stars for heating and DHW

| | |
|------------------------------------|---|
| Main heating energy efficiency | $3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4 |
| Main heating environmental impact | $0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4 |
| Water heating energy efficiency | $3.48 / 0.8864 = 3.926$, stars = 4 |
| Water heating environmental impact | $0.216 / 0.8864 = 0.2437$, 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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 74.0488 | 73.1952 | 73.4738 | 72.3955 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.1825 | 72.3955 | 72.3955 | 73.1952 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.3334 (39) |
| HLP | 1.2973 | 1.2823 | 1.2872 | 1.2683 | 1.2683 | 1.2471 | 1.2471 | 1.2431 | 1.2471 | 1.2683 | 1.2683 | 1.2823 (40) |
| HLP (average) | | | | | | | | | | | | 1.2672 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Water storage loss: | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|-----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | (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 | (63) |
| Output from w/h | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 1411.7091 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|------------|--------------------------------|------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 | (77) | | | | | | |
| Southeast | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 | (77) | | | | | | |
| Northwest | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 | (81) | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 | (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 | (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) | 21.4123 | 21.6620 | 21.5799 | 21.9013 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.2745 | 21.9013 | 21.9013 | 21.6620 | (85) |
| tau | 2.4275 | 2.4441 | 2.4387 | 2.4601 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4850 | 2.4601 | 2.4601 | 2.4441 | |
| util living area | 0.9132 | 0.8908 | 0.8453 | 0.7660 | 0.6598 | 0.5013 | 0.4042 | 0.4195 | 0.6040 | 0.7883 | 0.9224 | 0.9215 | (86) |
| MIT | 18.9286 | 19.1601 | 19.5901 | 20.1123 | 20.5381 | 20.8384 | 20.9292 | 20.9234 | 20.7263 | 20.1907 | 19.2822 | 18.8884 | (87) |
| Th 2 | 19.8430 | 19.8547 | 19.8509 | 19.8657 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8825 | 19.8657 | 19.8657 | 19.8547 | (88) |
| util rest of house | 0.9006 | 0.8754 | 0.8231 | 0.7320 | 0.6072 | 0.4260 | 0.3103 | 0.3234 | 0.5322 | 0.7494 | 0.9083 | 0.9100 | (89) |
| MIT 2 | 17.1530 | 17.4870 | 18.0911 | 18.8193 | 19.3812 | 19.7497 | 19.8404 | 19.8397 | 19.6344 | 18.9447 | 17.6854 | 17.1035 | (90) |
| Living area fraction | 17.7101 | 18.0120 | 18.5615 | 19.2250 | 19.7442 | 20.0913 | 20.1821 | 20.1798 | 19.9770 | 19.3357 | 18.1864 | 17.6636 | (91) |
| MIT | 17.7101 | 18.0120 | 18.5615 | 19.2250 | 19.7442 | 20.0913 | 20.1821 | 20.1798 | 19.9770 | 19.3357 | 18.1864 | 17.6636 | (92) |
| Temperature adjustment | 17.5601 | 17.8620 | 18.4115 | 19.0750 | 19.5942 | 19.9413 | 20.0321 | 20.0298 | 19.8270 | 19.1857 | 18.0364 | -0.1500 | |
| adjusted MIT | 17.5601 | 17.8620 | 18.4115 | 19.0750 | 19.5942 | 19.9413 | 20.0321 | 20.0298 | 19.8270 | 19.1857 | 18.0364 | 17.5136 | (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|---------|------|
| Useful gains | 0.8676 | 0.8411 | 0.7889 | 0.7047 | 0.5933 | 0.4302 | 0.3235 | 0.3365 | 0.5283 | 0.7218 | 0.8771 | 0.8782 | (94) | |
| Ext temp. | 471.7935 | 504.5846 | 519.6048 | 507.5883 | 434.7525 | 320.7479 | 226.2617 | 224.4397 | 331.8682 | 409.7730 | 365.3992 | 450.6338 | (95) | |
| Heat loss rate W | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 | (96) | |
| Month fracti | 937.4667 | 919.4758 | 838.4438 | 707.6681 | 535.3076 | 351.7370 | 237.1839 | 236.2722 | 386.3094 | 585.3657 | 741.0726 | 923.2534 | (97) | |
| Space heating kWh | 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 | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 | (98) | |
| Space heating per m2 | | | | | | | | | | | | 1834.1093 | (98) | |
| | | | | | | | | | | | | (98) / (4) = | 32.1323 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 | (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 | (208) |
| Space heating requirement | | | | | | | | | | | | | 2026.6401 | (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Space heating requirement | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 | (98) | |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) | |
| Space heating fuel (main heating system) | 382.8296 | 308.0739 | 262.1174 | 159.1795 | 82.6663 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 144.3547 | 298.8783 | 388.5403 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) | |
| Efficiency of water heater (217)m | 89.5395 | 89.4804 | 89.3367 | 89.0492 | 88.5569 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 88.9417 | 89.4420 | 87.3000 | (216) | |
| Fuel for water heating, kWh/month | 160.0967 | 140.5443 | 146.2989 | 129.4318 | 125.9845 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.4890 | 144.0893 | 155.4793 | (219) | |
| Water heating fuel used | | | | | | | | | | | | | 1591.5356 | (219) |
| Annual totals kWh/year | | | | | | | | | | | | | 2026.6401 | (211) |
| Space heating fuel - main system | | | | | | | | | | | | | 0.0000 | (215) |
| Space heating fuel - secondary | | | | | | | | | | | | | 30.0000 | (230c) |
| Electricity for pumps and fans: | | | | | | | | | | | | | 45.0000 | (230e) |
| central heating pump | | | | | | | | | | | | | 75.0000 | (231) |
| main heating flue fan | | | | | | | | | | | | | 270.1038 | (232) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 3963.2795 | (238) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | | |
| Total delivered energy for all uses | | | | | | | | | | | | | | |

10a. Fuel costs - using BEDF prices (485)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|-------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 2026.6401 | 3.7400 | 75.7963 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 1591.5356 | 3.7400 | 59.5234 (247) |
| Pumps and fans for heating | 75.0000 | 19.1200 | 14.3400 (249) |
| Energy for lighting | 270.1038 | 19.1200 | 51.6438 (250) |
| Additional standing charges | | | 94.0000 (251) |
| Total energy cost | | | 295.3036 (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 | 2026.6401 | 0.2160 | 437.7543 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1591.5356 | 0.2160 | 343.7717 (264) |
| Space and water heating | | | 781.5259 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total kg/year | | | 960.6348 (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 | 2026.6401 | 1.2200 | 2472.5009 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1591.5356 | 1.2200 | 1941.6735 (264) |
| Space and water heating | | | 4414.1743 (265) |
| Pumps and fans | 75.0000 | 3.0700 | 230.2500 (267) |
| Energy for lighting | 270.1038 | 3.0700 | 829.2187 (268) |
| Primary energy kWh/year | | | 5473.6430 (272) |
| Primary energy kWh/m2/year | | | 95.8942 (273) |

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
 Current environmental impact rating: B 87

(For testing purposes):

A Not considered
 B Not considered

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | |
|----|---------------------------|-------------------|
| 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 | Recommended |
| 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 | + 1.4 | -£ 23 | -162 kg (16.9%) |
| U Solar photovoltaic panels | + 13.1 | -£ 349 | -946 kg (118.5%) |

| Recommended measures | Typical annual savings | | Energy efficiency | Environmental impact |
|---------------------------|------------------------|-------------------------------|-------------------|----------------------|
| Solar water heating | £23 | 2.84 kg/m ² | B 84 | B 89 |
| Solar photovoltaic panels | £349 | 16.58 kg/m ² | A 97 | A 101 |
| Total Savings | £372 | 19.42 kg/m² | | |

Potential energy efficiency rating: A 97
 Potential environmental impact rating: A 101

Fuel prices for cost data on this page from database revision number 485 TEST (29 Oct 2021)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

| | Current | Potential | Saving |
|----------------------------------|-----------------------|------------------------|------------------------|
| Electricity | £66 | £76 | -£10 |
| Mains gas | £229 | £197 | £33 |
| Space heating | £184 | £184 | £0 |
| Water heating | £60 | £37 | £23 |
| Lighting | £52 | £52 | £0 |
| Generated (PV) | -£0 | -£349 | £349 |
| Total cost of fuels | £295 | -£76 | £372 |
| Total cost of uses | £296 | -£76 | £372 |
| Delivered energy | 69 kWh/m ² | 23 kWh/m ² | 46 kWh/m ² |
| Carbon dioxide emissions | 1.0 tonnes | -0.1 tonnes | 1.1 tonnes |
| CO2 emissions per m ² | 17 kg/m ² | -3 kg/m ² | 19 kg/m ² |
| Primary energy | 96 kWh/m ² | -18 kWh/m ² | 114 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 (m2) | Storey height (m) | Volume (m3) |
|--|--------------|---------------------------------|-----------------------|
| Ground floor | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | 5.0000 |
| Measured/design AP50 | | | | | 0.5378 (18) |
| Infiltration rate | | | | | 2 (19) |
| Number of sides sheltered | | | | | |
| Shelter factor | | | (20) = 1 - [0.075 x (19)] = | | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | (21) = (18) x (20) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 30.7236 | 30.4211 | 30.1246 | 28.7318 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.7255 | 28.4713 | 28.9984 | 29.5495 (38) |
| Heat transfer coeff | 74.6478 | 74.3453 | 74.0488 | 72.6561 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.6498 | 72.3955 | 72.9227 | 73.4738 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.6549 (39) |
| HLP | 1.3078 | 1.3025 | 1.2973 | 1.2729 | 1.2683 | 1.2471 | 1.2471 | 1.2431 | 1.2553 | 1.2683 | 1.2776 | 1.2872 (40) |
| HLP (average) | | | | | | | | | | | | 1.2729 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (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 | | | | | | | | | | | | | | | 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 | | | | | | | | | | | | | | | 1.4540 (H8) |
| Utilisation factor | | | | | | | | | | | | | | | 0.4973 (H9) |
| Collector performance factor | | | | | | | | | | | | | | | 0.8793 (H10) |
| Dedicated solar storage volume | | | | | | | | | | | | | | | 75.0000 (H11) |
| Effective solar volume | | | | | | | | | | | | | | | 75.0000 (H13) |
| Daily hot water demand | | | | | | | | | | | | | | | 79.2773 (H14) |
| Volume ratio Veff/V | | | | | | | | | | | | | | | 0.9460 (H15) |
| Solar storage volume factor | | | | | | | | | | | | | | | 0.9889 (H16) |
| Solar input | | | | | | | | | | | | | | | -784.2477 (H17) |
| Solar input | -22.7416 | -37.9492 | -64.6319 | -86.6194 | -107.0110 | -105.2089 | -103.8185 | -90.7068 | -71.0416 | -48.5130 | -26.9748 | -19.0309 | -19.0309 | -19.0309 | (63) |
| Solar input (sum of months) = Sum(63)m = | | | | | | | | | | | | | | | -784.2477 (63) |
| Output from w/h | 120.6081 | 87.8104 | 66.0667 | 28.6385 | 4.5569 | 0.0000 | 0.0000 | 12.7998 | 33.1000 | 71.1038 | 101.9015 | 120.2297 | 120.2297 | 120.2297 | (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | | | | 646.8155 (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 |
| 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 |
| Losses e.g. evaporation (negative values) (Table 5) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 |

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 | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|----------|
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 37.2574 (77) | | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 40.5522 (77) | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7700 | 12.8629 (81) | | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 |
| Total gains | 527.7187 | 592.2188 | 645.4015 | 693.4074 | 721.0509 | 702.6288 | 672.6371 | 638.3133 | 603.2324 | 553.6979 | 513.2945 | 502.4750 |

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 | 21.2405 | 21.3269 | 21.4123 | 21.8227 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.1293 | 21.9013 | 21.7430 | 21.5799 |
| alpha | 2.4160 | 2.4218 | 2.4275 | 2.4548 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4753 | 2.4601 | 2.4495 | 2.4387 |
| util living area | 0.9237 | 0.8990 | 0.8595 | 0.7891 | 0.6862 | 0.5487 | 0.4256 | 0.4593 | 0.6385 | 0.8103 | 0.8969 | 0.9306 |
| MIT | 18.7470 | 19.0243 | 19.4545 | 20.0035 | 20.4634 | 20.7879 | 20.9185 | 20.8992 | 20.6702 | 20.0851 | 19.3417 | 18.7090 |
| Th 2 | 19.8347 | 19.8389 | 19.8430 | 19.8621 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8761 | 19.8657 | 19.8585 | 19.8509 |
| util rest of house | 0.9127 | 0.8848 | 0.8393 | 0.7579 | 0.6376 | 0.4758 | 0.3306 | 0.3642 | 0.5700 | 0.7755 | 0.8802 | 0.9206 |
| MIT 2 | 16.8879 | 17.2845 | 17.8962 | 18.6710 | 19.2869 | 19.6977 | 19.8324 | 19.8197 | 19.5663 | 18.8027 | 17.7573 | 16.8429 |
| Living area fraction | | | | | | | | | | | | |
| MIT | 17.4712 | 17.8304 | 18.3852 | 19.0891 | 19.6561 | 20.0397 | 20.1732 | 20.1585 | 19.9127 | 19.2051 | 18.2544 | 17.4285 |
| Temperature adjustment | | | | | | | | | | | | -0.1500 |
| adjusted MIT | 17.3212 | 17.6804 | 18.2352 | 18.9391 | 19.5061 | 19.8897 | 20.0232 | 20.0085 | 19.7627 | 19.0551 | 18.1044 | 17.2785 |

8. Space heating requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation | 0.8807 | 0.8504 | 0.8045 | 0.7283 | 0.6204 | 0.4763 | 0.3432 | 0.3754 | 0.5623 | 0.7457 | 0.8465 | 0.8900 (94) |
| Useful gains | 464.7593 | 503.6492 | 519.2133 | 505.0089 | 447.3155 | 334.6927 | 230.8343 | 239.5943 | 339.1938 | 412.8948 | 434.5250 | 447.2053 (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 | | | | | | | | | | | | |
| Month fracti | 972.0055 | 950.1657 | 868.9748 | 729.3997 | 565.1244 | 376.5362 | 243.6704 | 256.0485 | 405.7301 | 612.1125 | 802.4717 | 960.9235 (97) |
| Space heating kWh | 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 | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 (98) |
| Space heating per m2 | | | | | | | | | | | | 1982.2300 (98) |
| | | | | | | | | | | | | (98) / (4) = 34.7272 (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) | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | 2190.3094 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating requirement | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 (210) |
| Space heating fuel (main heating system) | 417.0068 | 331.5570 | 287.5387 | 178.5209 | 96.8507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 163.7768 | 292.7311 | 422.3275 (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 | 120.6081 | 87.8104 | 66.0667 | 28.6385 | 4.5569 | 0.0000 | 0.0000 | 12.7998 | 33.1000 | 71.1038 | 101.9015 | 120.2297 (64) |
| Efficiency of water heater | 89.7037 | 89.7552 | 89.8333 | 90.0033 | 90.3364 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.4372 | 89.5878 | 87.3000 (216) |
| (217)m | 89.7037 | 89.7552 | 89.8333 | 90.0033 | 90.3364 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.4372 | 89.5878 | 89.7131 (217) |
| Fuel for water heating, kWh/month | 134.4517 | 97.8333 | 73.5437 | 31.8194 | 5.0444 | 0.0000 | 0.0000 | 14.6619 | 37.9153 | 79.5014 | 113.7449 | 134.0158 (219) |
| Water heating fuel used | | | | | | | | | | | | 722.5317 (219) |
| Annual totals kWh/year | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | 2190.3094 (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) |
| pump for solar water heating | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 125.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 270.1038 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = | | | | | | | | | | -1727.2394 | | -1727.2394 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | 1580.7055 (238) |

10a. Fuel costs - using Table 12 prices

| | | | |
|---------------------------------------|---------------|------------------|------------------|
| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
| Space heating - main system 1 | 2190.3094 | 3.4800 | 76.2228 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 722.5317 | 3.4800 | 25.1441 (247) |
| 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 | 270.1038 | 13.1900 | 35.6267 (250) |
| Additional standing charges | | | 120.0000 (251) |
| Energy saving/generation technologies | | | |
| PV Unit | -1727.2394 | 13.1900 | -227.8229 (252) |
| Total energy cost | | | 45.6582 (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|----------------------------------|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | [(255) x (256)] / [(4) + 45.0] = | 0.1879 (257) |
| SAP value | | 97.3794 |
| SAP rating (Section 12) | | 97 (258) |
| SAP band | | A |

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 | 2190.3094 | 0.2160 | 473.1068 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 722.5317 | 0.2160 | 156.0668 (264) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | |
|---------------------------------------|------------|--------|-----------------|
| Space and water heating | | | 629.1737 (265) |
| Pumps and fans | 125.0000 | 0.5190 | 64.8750 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1727.2394 | 0.5190 | -896.4372 (269) |
| Total kg/year | | | -62.2047 (272) |
| CO2 emissions per m2 | | | -1.0900 (273) |
| EI value | | | 100.8166 |
| EI rating | | | 101 (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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 74.0488 | 73.1952 | 73.4738 | 72.3955 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.1825 | 72.3955 | 72.3955 | 73.1952 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.3334 (39) |
| HLP | 1.2973 | 1.2823 | 1.2872 | 1.2683 | 1.2683 | 1.2471 | 1.2471 | 1.2431 | 1.2471 | 1.2683 | 1.2683 | 1.2823 (40) |
| HLP (average) | | | | | | | | | | | | 1.2672 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | (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 | | | | | | | | | | | | | | 1139.7099 (H5) |
| Overshading factor | | | | | | | | | | | | | | 0.8000 (H6) |
| Solar energy available | | | | | | | | | | | | | | 1914.7126 (H7) |
| Adjustment factor for showers | | | | | | | | | | | | | | 1.0000 (H7a) |
| Solar-to-load ratio | | | | | | | | | | | | | | 1.5350 (H8) |
| Utilisation factor | | | | | | | | | | | | | | 0.4787 (H9) |
| Collector performance factor | | | | | | | | | | | | | | 0.8793 (H10) |
| Dedicated solar storage volume | | | | | | | | | | | | | | 75.0000 (H11) |
| Effective solar volume | | | | | | | | | | | | | | 75.0000 (H13) |
| Daily hot water demand | | | | | | | | | | | | | | 79.2773 (H14) |
| Volume ratio Veff/V | | | | | | | | | | | | | | 0.9460 (H15) |
| Solar storage volume factor | | | | | | | | | | | | | | 0.9889 (H16) |
| Solar input | | | | | | | | | | | | | | -797.0145 (H17) |
| Solar input | -26.1366 | -38.8057 | -66.4777 | -91.2580 | -106.5291 | -113.2936 | -107.7339 | -95.8834 | -75.7071 | -50.9881 | -3.0549 | -21.1463 | -21.1463 | (63) |
| Solar input (sum of months) = Sum (63)m = | | | | | | | | | | | | | | -797.0145 (63) |
| Output from w/h | 117.2131 | 86.9540 | 64.2209 | 24.0000 | 5.0389 | 0.0000 | 0.0000 | 7.6232 | 28.4345 | 68.6287 | 125.8214 | 118.1143 | 118.1143 | (64) |
| Total per year (kWh/year) = Sum (64)m = | | | | | | | | | | | | | | 646.0488 (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | (65) |

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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | | |
| (66)m | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | 425.3817 | (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 | | | | | | | |
| Southeast | | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 (77) | | | | | | | |
| Southeast | | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 (77) | | | | | | | |
| Northwest | | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 (81) | | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 | 87.7686 | (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 | 513.1503 | (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) | | | | | | | | | | | | | | |
| tau | 21.4123 | 21.6620 | 21.5799 | 21.9013 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.2745 | 21.9013 | 21.9013 | 21.6620 | 21.6620 | |
| alpha | 2.4275 | 2.4441 | 2.4387 | 2.4601 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4850 | 2.4601 | 2.4601 | 2.4441 | 2.4441 | |
| util living area | 0.9132 | 0.8908 | 0.8453 | 0.7660 | 0.6598 | 0.5013 | 0.4042 | 0.4195 | 0.6040 | 0.7883 | 0.9224 | 0.9215 | 0.9215 | (86) |
| MIT | 18.9286 | 19.1601 | 19.5901 | 20.1123 | 20.5381 | 20.8384 | 20.9292 | 20.9234 | 20.7263 | 20.1907 | 19.2822 | 18.8884 | 18.8884 | (87) |
| Th 2 | 19.8430 | 19.8547 | 19.8509 | 19.8657 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8825 | 19.8657 | 19.8657 | 19.8547 | 19.8547 | (88) |
| util rest of house | 0.9006 | 0.8754 | 0.8231 | 0.7320 | 0.6072 | 0.4260 | 0.3103 | 0.3234 | 0.5322 | 0.7494 | 0.9083 | 0.9100 | 0.9100 | (89) |
| MIT 2 | 17.1530 | 17.4870 | 18.0911 | 18.8193 | 19.3812 | 19.7497 | 19.8404 | 19.8397 | 19.6344 | 18.9447 | 17.6854 | 17.1035 | 17.1035 | (90) |
| Living area fraction | | | | | | | | | | | | | | 0.3138 (91) |
| MIT | 17.7101 | 18.0120 | 18.5615 | 19.2250 | 19.7442 | 20.0913 | 20.1821 | 20.1798 | 19.9770 | 19.3357 | 18.1864 | 17.6636 | 17.6636 | (92) |
| Temperature adjustment | | | | | | | | | | | | | | -0.1500 |
| adjusted MIT | 17.5601 | 17.8620 | 18.4115 | 19.0750 | 19.5942 | 19.9413 | 20.0321 | 20.0298 | 19.8270 | 19.1857 | 18.0364 | 17.5136 | 17.5136 | (93) |

8. Space heating requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation | 0.8676 | 0.8411 | 0.7889 | 0.7047 | 0.5933 | 0.4302 | 0.3235 | 0.3365 | 0.5283 | 0.7218 | 0.8771 | 0.8782 (94) |
| Useful gains | 471.7935 | 504.5846 | 519.6048 | 507.5883 | 434.7525 | 320.7479 | 226.2617 | 224.4397 | 331.8682 | 409.7730 | 365.3992 | 450.6338 (95) |
| Ext temp. | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 (96) |
| Heat loss rate W | | | | | | | | | | | | |
| | 937.4667 | 919.4758 | 838.4438 | 707.6681 | 535.3076 | 351.7370 | 237.1839 | 236.2722 | 386.3094 | 585.3657 | 741.0726 | 923.2534 (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 | | | | | | | | | | | | |
| | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 (98) |
| Space heating | | | | | | | | | | | | 1834.1093 (98) |
| Space heating per m2 | | | | | | | | | | | | (98) / (4) = 32.1323 (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) | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | 2026.6401 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating requirement | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 (210) |
| Space heating fuel (main heating system) | 382.8296 | 308.0739 | 262.1174 | 159.1795 | 82.6663 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 144.3547 | 298.8783 | 388.5403 (211) |
| Water heating requirement | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | 117.2131 | 86.9540 | 64.2209 | 24.0000 | 5.0389 | 0.0000 | 0.0000 | 7.6232 | 28.4345 | 68.6287 | 125.8214 | 118.1143 (64) |
| Efficiency of water heater | 89.6691 | 89.7182 | 89.7987 | 90.0287 | 90.2912 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.3718 | 89.4589 | 87.3000 (216) |
| (217)m | 89.6691 | 89.7182 | 89.7987 | 90.0287 | 90.2912 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.3718 | 89.4589 | 89.6735 (217) |
| Fuel for water heating, kWh/month | 130.7173 | 96.9190 | 71.5165 | 26.6581 | 5.5807 | 0.0000 | 0.0000 | 8.7321 | 32.5710 | 76.7901 | 140.6472 | 131.7159 (219) |
| Water heating fuel used | | | | | | | | | | | | 721.8480 (211) |
| Annual totals kWh/year | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | 2026.6401 (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) |
| pump for solar water heating | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 125.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 270.1038 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = | | | | | | | | | -1823.5358 | | | -1823.5358 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | 1320.0560 (238) |

10a. Fuel costs - using BEDF prices (485)

| | | | |
|---------------------------------------|---------------|------------------|------------------|
| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
| Space heating - main system 1 | 2026.6401 | 3.7400 | 75.7963 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 721.8480 | 3.7400 | 26.9971 (247) |
| Pumps and fans for heating | 75.0000 | 19.1200 | 14.3400 (249) |
| Pump for solar water heating | 50.0000 | 19.1200 | 9.5600 (249) |
| Energy for lighting | 270.1038 | 19.1200 | 51.6438 (250) |
| Additional standing charges | | | 94.0000 (251) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 19.1200 | -348.6600 (252) |
| Total energy cost | | | -76.3227 (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 | 2026.6401 | 0.2160 | 437.7543 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 721.8480 | 0.2160 | 155.9192 (264) |
| Space and water heating | | | 593.6734 (265) |
| Pumps and fans | 125.0000 | 0.5190 | 64.8750 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 0.5190 | -946.4151 (269) |
| Total kg/year | | | -147.6828 (272) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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 | 2026.6401 | 1.2200 | 2472.5009 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 721.8480 | 1.2200 | 880.6545 (264) |
| Space and water heating | | | 3353.1554 (265) |
| Pumps and fans | 125.0000 | 3.0700 | 383.7500 (267) |
| Energy for lighting | 270.1038 | 3.0700 | 829.2187 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 3.0700 | -5598.2549 (269) |
| Primary energy kWh/year | | | -1032.1308 (272) |
| Primary energy kWh/m2/year | | | -18.0822 (273) |

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

Overheating Calculation Input Data

| | |
|---|--------------------------|
| Dwelling type | EndTerrace House |
| Number of storeys | 2 |
| Cross ventilation possible | Yes |
| SAP Region | Severn Valley |
| Front of dwelling faces | North West |
| Overshading | Average or unknown |
| Thermal mass parameter | 100.0 |
| Night ventilation | No |
| Ventilation rate during hot weather (ach) | 4.00 (Windows half open) |

Overheating Calculation

| | |
|--|-------------|
| Summer ventilation heat loss coefficient | 183.47 (P1) |
| Transmission heat loss coefficient | 43.92 (37) |
| Summer heat loss coefficient | 227.39 (P2) |

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

| Solar shading Orientation | Z blinds | Solar access | Z overhangs | Z summer |
|---------------------------|----------|--------------|-------------|------------|
| South East | 0.850 | 0.90 | 1.000 | 0.765 (P8) |
| North West | 0.850 | 0.90 | 1.000 | 0.765 (P8) |

| [Jul] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Shading | Gains W |
|------------|---------|--------------------------|-----------------------------|------------------------------|---------|----------|
| South East | 2.9400 | 121.5729 | 0.7100 | 0.7000 | 0.7650 | 122.3050 |
| South East | 3.2000 | 121.5729 | 0.7100 | 0.7000 | 0.7650 | 133.1211 |
| North West | 3.3100 | 100.3588 | 0.7100 | 0.7000 | 0.7650 | 113.6695 |

total: 369.0956

| | Jun | Jul | Aug |
|--|-----------------|--------|--------|
| Solar gains | 401 | 369 | 330 |
| Internal gains | 339 | 325 | 332 |
| Total summer gains | 740 | 694 | 662 |
| Summer gain/loss ratio | 3.25 | 3.05 | 2.91 |
| Summer external temperature | 15.00 | 16.70 | 16.70 |
| Thermal mass temperature increment (TMP = 100.0) | 1.30 | 1.30 | 1.30 |
| Threshold temperature | 19.55 | 21.05 | 20.91 |
| Likelihood of high internal temperature | Not significant | Slight | Slight |

Assessment of likelihood of high internal temperature: Slight

ASSESSMENT NOTES

Calculation Type: New Build (As Designed)



| | | | |
|----------------------|---------------|----------------|----------------------|
| Property Reference | Plot 003 | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 3 | Prop Type Ref | Washington Eaves MID |
| Property | 2 bed, 1 bath | | |

| | | | | | |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating | 84 B | DER | 17.10 | TER | 18.36 |
| Environmental | 88 B | % DER<TER | 6.86 | | |
| CO ₂ Emissions (t/year) | 0.87 | DFEE | 37.98 | TFEE | 43.79 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 13.27 | | |

| | | | |
|------------------|--|-------------|-----------|
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | Assessor ID | R034-0001 |
|------------------|--|-------------|-----------|

| | |
|--------|--|
| Client | |
|--------|--|

ASSESSMENT NOTES - Last time updated on: 17.11.2021

Celotex and ISOVER are separate legal entities to Darren Evans Assessments. Darren Evans Assessments provides the warranty and assumes responsibility for the Energy Assessments Service offered under a commercial agreement with Celotex and ISOVER

PREDICTED ENERGY ASSESSMENT



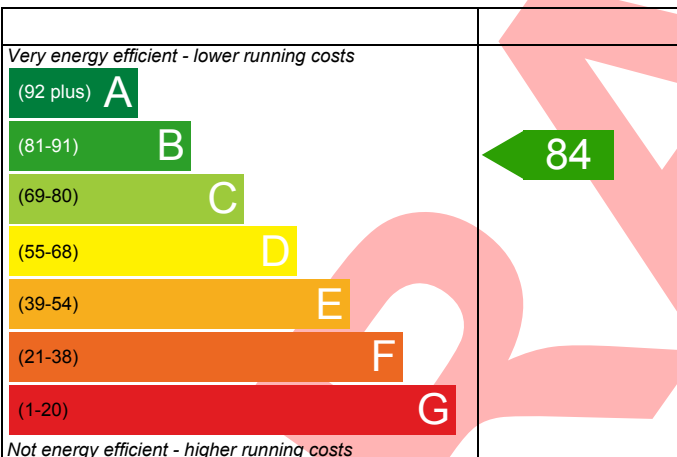
2 bed,
1 bath

Dwelling type: House, Mid-Terrace
Date of assessment: 17/11/2021
Produced by: Michael Brogden
Total floor area: 57.08 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.

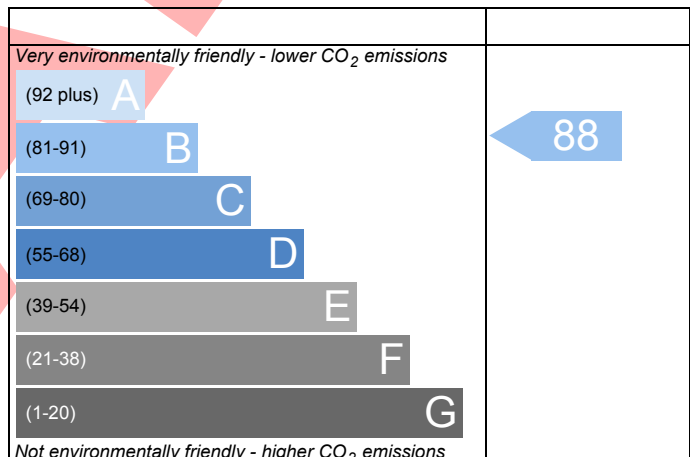
Energy Efficiency Rating



England EU Directive 2002/91/EC

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO₂) Rating



England EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



| | | | |
|----------------------|---------------|----------------|----------------------|
| Property Reference | Plot 003 | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 3 | Prop Type Ref | Washington Eaves MID |
| Property | 2 bed, 1 bath | | |

| | | | | | |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating | 84 B | DER | 17.10 | TER | 18.36 |
| Environmental | 88 B | % DER<TER | 6.86 | | |
| CO ₂ Emissions (t/year) | 0.87 | DFEE | 37.98 | TFEE | 43.79 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 13.27 | | |

| | | | |
|------------------|--|-------------|-----------|
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | Assessor ID | R034-0001 |
|------------------|--|-------------|-----------|

| | |
|--------|--|
| Client | |
|--------|--|

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

| | |
|-----------------------|--------------------|
| Orientation | North West |
| Property Tenure | Unknown |
| Transaction Type | New dwelling |
| Terrain Type | Urban |
| 1.0 Property Type | House, Mid-Terrace |
| 2.0 Number of Storeys | 2 |
| 3.0 Date Built | 2021 |
| 4.0 Sheltered Sides | 2 |
| 5.0 Sunlight/Shade | Average or unknown |

6.0 Measurements

| | Heat Loss Perimeter | Internal Floor Area | Average Storey Height |
|---------------|---------------------|----------------------|-----------------------|
| Ground Floor: | 7.99 m | 28.54 m ² | 2.31 m |
| 1st Storey: | 7.99 m | 28.54 m ² | 2.56 m |

| | | |
|-----------------|-------|----------------|
| 7.0 Living Area | 17.91 | m ² |
|-----------------|-------|----------------|

| | | |
|----------------------------|--------------------------|---------------------|
| 8.0 Thermal Mass Parameter | Simple calculation - Low | |
| Thermal Mass | 100.00 | kJ/m ² K |

9.0 External Walls

| Description | Type | U-Value (W/m ² K) | Gross Area (m ²) | Nett Area (m ²) |
|-----------------|-------------|------------------------------|------------------------------|-----------------------------|
| External Wall 1 | Cavity Wall | 0.27 | 38.89 | 27.51 |

9.1 Party Walls

| Description | Type | Construction | U-Value (W/m ² K) | Area (m ²) |
|--------------|---------------------------------|--------------|------------------------------|------------------------|
| Party Wall 1 | Filled Cavity with Edge Sealing | | 0.00 | 69.61 |

10.0 External Roofs

| Description | Type | U-Value (W/m ² K) | Gross Area (m ²) | Nett Area (m ²) |
|-----------------|---------------------|------------------------------|------------------------------|-----------------------------|
| External Roof 1 | External Plane Roof | 0.10 | 28.54 | 28.54 |

10.2 Internal Ceilings

| Description | Construction | Area (m ²) |
|-------------|--------------|------------------------|
|-------------|--------------|------------------------|

11.0 Heat Loss Floors

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



| Description | Type | Construction | U-Value (W/m²K) | Area (m²) |
|-------------------|----------------------|--------------|-----------------|-----------|
| Heat Loss Floor 1 | Ground Floor - Solid | | 0.15 | 28.54 |

11.2 Internal Floors

| Description | Construction | Area (m²) |
|-------------|--------------|-----------|
| | | |

12.0 Opening Types

| Description | Data Source | Type | Glazing | Glazing Gap | Argon Filled | G-value | Frame Type | Frame Factor | U Value (W/m²K) |
|------------------------|--------------|------------|---------------|-------------|--------------|---------|------------|--------------|-----------------|
| French Door | Manufacturer | Window | Double glazed | | | 0.71 | | 0.70 | 1.41 |
| Window | Manufacturer | Window | Double glazed | | | 0.71 | | 0.70 | 1.41 |
| Solid door tall window | Manufacturer | Solid Door | | | | | | | 1.20 |

13.0 Openings

| Name | Opening Type | Location | Orientation | Curtain Type | Overhang Ratio | Wide Overhang | Width (m) | Height (m) | Count | Area (m²) | Curtain Closed |
|------------------|--------------|---------------------|-------------|---------------------------------------|----------------|---------------|-----------|------------|-------|-----------|----------------|
| Front door | Solid Door | [1] External Wall 1 | North West | | | | | | | 1.93 | |
| front windows | Window | [1] External Wall 1 | North West | Dark-coloured curtain or roller blind | 0.00 | | | | | 3.31 | 100 |
| rear french door | Window | [1] External Wall 1 | South East | Dark-coloured curtain or roller blind | 0.00 | | | | | 2.94 | 100 |
| rear windows | Window | [1] External Wall 1 | South East | Dark-coloured curtain or roller blind | 0.00 | | | | | 3.20 | 100 |

14.0 Conservatory

15.0 Draught Proofing

 %

16.0 Draught Lobby

17.0 Thermal Bridging

17.1 List of Bridges

| Source Type | Bridge Type | Length | Psi | Imported | Reference: |
|------------------------|--|--------|-------|----------|------------------------------|
| Independently assessed | E2 Other lintels (including other steel lintels) | 7.00 | 0.211 | No | H+H LN01 - EW01 |
| Independently assessed | E3 Sill | 3.68 | 0.019 | No | APA PF-WD-03 |
| Independently assessed | E4 Jamb | 15.60 | 0.020 | No | APA PF-WD-04 |
| Independently assessed | E5 Ground floor (normal) | 7.99 | 0.044 | No | GF02 - EW01 |
| Independently assessed | E6 Intermediate floor within a dwelling | 7.99 | 0.001 | No | APA PF-IF-01 |
| Table K1 - Approved | E10 Eaves (insulation at ceiling level) | 7.99 | 0.060 | No | |
| Table K1 - Approved | E18 Party wall between dwellings | 19.48 | 0.060 | No | |
| Independently assessed | P1 Party wall - Ground floor | 14.29 | 0.053 | No | PW01 - EW01 |
| Table K1 - Default | P2 Party wall - Intermediate floor within a dwelling | 14.29 | 0.000 | No | |
| Independently assessed | P4 Party wall - Roof (insulation at ceiling level) | 14.29 | 0.036 | No | Barratt Confidential Bespoke |

Y-value

 W/m²K

18.0 Pressure Testing

Designed AP₅₀

 m³/(h.m²) @ 50 Pa

Property Tested ?

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



As Built AP₅₀

m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

| | |
|-----------------------------|--|
| Windows open in hot weather | <input type="text" value="Windows half open"/> |
| Cross ventilation possible | <input type="text" value="Yes"/> |
| Night Ventilation | <input type="text" value="No"/> |
| Air change rate | <input type="text" value="4.00"/> |

Mechanical Ventilation

| | |
|---------------------------------------|---------------------------------|
| Mechanical Ventilation System Present | <input type="text" value="No"/> |
|---------------------------------------|---------------------------------|

20.0 Fans, Open Fireplaces, Flues

| | MHS | SHS | Other | Total |
|------------------------------|-----|-----|-------|-------|
| Number of Chimneys | 0 | | 0 | 0 |
| Number of open flues | 0 | | 0 | 0 |
| Number of intermittent fans | | | | 4 |
| Number of passive vents | | | | 0 |
| Number of flueless gas fires | | | | 0 |

21.0 Fixed Cooling System

22.0 Lighting

Internal

| | | |
|---------------------------------|-------------------------------------|---|
| Total number of light fittings | <input type="text" value="15"/> | |
| Total number of L.E.L. fittings | <input type="text" value="15"/> | |
| Percentage of L.E.L. fittings | <input type="text" value="100.00"/> | % |

External

| | |
|------------------------|---------------------------------|
| External lights fitted | <input type="text" value="No"/> |
|------------------------|---------------------------------|

23.0 Electricity Tariff

24.0 Main Heating 1

| | | |
|---------------------|--|---|
| | <input type="text" value="Database"/> | |
| Percentage of Heat | <input type="text" value="100"/> | % |
| Database Ref. No. | <input type="text" value="17929"/> | |
| Fuel Type | <input type="text" value="Mains gas"/> | |
| Main Heating | <input type="text" value="BGW"/> | |
| SAP Code | <input type="text" value="104"/> | |
| In Winter | <input type="text" value="90.5"/> | |
| In Summer | <input type="text" value="87.3"/> | |
| Controls | <input type="text" value="CBI Time and temperature zone control"/> | |
| PCDF Controls | <input type="text" value="0"/> | |
| Delayed Start Stat | <input type="text" value="Yes"/> | |
| Sap Code | <input type="text" value="2110"/> | |
| Flue Type | <input type="text" value="Balanced"/> | |
| Fan Assisted Flue | <input type="text" value="Yes"/> | |
| Is MHS Pumped | <input type="text" value="Pump in heated space"/> | |
| Heat Emitter | <input type="text" value="Radiators"/> | |
| Flow Temperature | <input type="text" value="Normal (> 45°C)"/> | |
| Combi boiler type | <input type="text" value="Standard Combi"/> | |
| Combi keep hot type | <input type="text" value="None"/> | |

25.0 Main Heating 2

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



| | |
|--|-------------------------|
| Community Heating | None |
| 28.0 Water Heating | HWP From main heating 1 |
| Water Heating | Main Heating 1 |
| Flue Gas Heat Recovery System | No |
| Waste Water Heat Recovery Instantaneous System 1 | No |
| Waste Water Heat Recovery Instantaneous System 2 | No |
| Waste Water Heat Recovery Storage System | No |
| Solar Panel | No |
| Water use <= 125 litres/person/day | Yes |
| SAP Code | 901 |
| 29.0 Hot Water Cylinder | None |

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

| | Typical Cost | Typical savings per year | Ratings after improvement | |
|------------------------------------|-----------------|--------------------------|---------------------------|----------------------|
| | | | SAP rating | Environmental Impact |
| Solar water heating | £4,000 - £6,000 | £23 | B 85 | |
| | Typical Cost | Typical savings per year | Ratings after improvement | |
| | | | SAP rating | Environmental Impact |
| Solar photovoltaic panels, 2.5 kWp | £3,500 - £5,500 | £349 | A 98 | |

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Designed)



| | | | |
|-----------------------------|---------------|-----------------------|----------------------|
| Property Reference | Plot 003 | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 3 | Prop Type Ref | Washington Eaves MID |
| Property | 2 bed, 1 bath | | |

| | | | | | |
|--|------|-----------------------|-------|-------------|-------|
| SAP Rating | 84 B | DER | 17.10 | TER | 18.36 |
| Environmental | 88 B | % DER<TER | 6.86 | | |
| CO₂ Emissions (t/year) | 0.87 | DFEE | 37.98 | TFEE | 43.79 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 13.27 | | |

| | | | |
|-------------------------|--|--------------------|-----------|
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | Assessor ID | R034-0001 |
|-------------------------|--|--------------------|-----------|

| | |
|---------------|--|
| Client | |
|---------------|--|

SUMMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

| | | | |
|---|------------------|-----------------------------------|------|
| Fuel for main heating | Mains gas | | |
| Fuel factor | 1.00 (mains gas) | | |
| Target Carbon Dioxide Emission Rate (TER) | 18.36 | kgCO ₂ /m ² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 17.10 | kgCO ₂ /m ² | Pass |
| | -1.26 (-6.9%) | kgCO ₂ /m ² | |

1b TFEE and DFEE

| | | | |
|--|---------------|------------------------|------|
| Target Fabric Energy Efficiency (TFEE) | 43.79 | kWh/m ² /yr | |
| Dwelling Fabric Energy Efficiency (DFEE) | 37.98 | kWh/m ² /yr | |
| | -5.8 (-13.2%) | kWh/m ² /yr | Pass |

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

| Element | Average | Highest | |
|---------------|------------------|------------------|------|
| External wall | 0.27 (max. 0.30) | 0.27 (max. 0.70) | Pass |
| Party wall | 0.00 (max. 0.20) | - | Pass |
| Floor | 0.15 (max. 0.25) | 0.15 (max. 0.70) | Pass |
| Roof | 0.10 (max. 0.20) | 0.10 (max. 0.35) | Pass |
| Openings | 1.37 (max. 2.00) | 1.41 (max. 3.30) | Pass |

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 | Pass |

Limiting System Efficiencies

4 Heating efficiency

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Designed)



Main heating system

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

Pass

Secondary heating system

None

5 Cylinder insulation

Hot water storage

No cylinder

6 Controls

Space heating controls

Time and temperature zone control

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100 %

Minimum

75 %

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Severn Valley)

Slight

Pass

Based on:

Overshading

Average

Windows facing South East

6.14 m², No overhang

Windows facing North West

3.31 m², No overhang

Air change rate

4.00 ach

Blinds/curtains

Dark-coloured curtain or roller blind, closed 100% of daylight hours

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type

U-value

Filled Cavity with Edge Sealing

0.00

W/m²K

Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

5.00 (design value)

Maximum

10.0

Pass

10 Key features

Party wall U-value

0.00

W/m²K

Roof U-value

0.10

W/m²K

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



| | | | | | |
|------------------------------------|--|---------------|----------------------|----------------|------------|
| Property Reference | Plot 003 | | | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 3 | Prop Type Ref | Washington Eaves MID | | |
| Property | 2 bed, 1 bath | | | | |
| SAP Rating | 84 B | DER | 17.10 | TER | 18.36 |
| Environmental | 88 B | % DER<TER | 6.86 | | |
| CO ₂ Emissions (t/year) | 0.87 | DFEE | 37.98 | TFEE | 43.79 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 13.27 | | |
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | | | Assessor ID | R034-0001 |
| Client | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

Mid-Terrace House, total floor area 57 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) 18.36 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.10 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)43.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)38.0 kWh/m²/yrOK

2 Fabric U-values

| Element | Average | Highest | |
|---------------|------------------|------------------|----|
| External wall | 0.27 (max. 0.30) | 0.27 (max. 0.70) | OK |
| Party wall | 0.00 (max. 0.20) | - | OK |
| Floor | 0.15 (max. 0.25) | 0.15 (max. 0.70) | OK |
| Roof | 0.10 (max. 0.20) | 0.10 (max. 0.35) | OK |
| Openings | 1.37 (max. 2.00) | 1.41 (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 database

Ideal LOGIC COMBI ESP1 35

Combi boiler

Efficiency: 89.6% SEDBUK2009

Minimum: 88.0%

OK

Secondary heating system:

None

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

Not applicable

9 Summertime temperature

Overheating risk (Severn Valley): Slight OK

Based on:

Overshading:

Average

Windows facing South East:

6.14 m², No overhang

Windows facing North West:

3.31 m², No overhang

Air change rate:

4.00 ach

Blinds/curtains:

Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.10 W/m²K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 |
|--|----------|-------------|------------|----------------------|-----------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.2700 | 7.4277 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 29.4918 | | (33) |
| Party Wall 1 | | | 69.6100 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1385 (36)
 Total fabric heat loss (33) + (36) = 34.6303 (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) | | | | | | | | | | | | |
| (38)m | 30.7236 | 30.4211 | 30.1246 | 28.7318 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.7255 | 28.4713 | 28.9984 | 29.5495 (38) |
| Heat transfer coeff | 65.3539 | 65.0514 | 64.7549 | 63.3621 | 63.1016 | 61.8885 | 61.8885 | 61.6639 | 62.3558 | 63.1016 | 63.6287 | 64.1798 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.3609 (39) |
| HLP | 1.1450 | 1.1397 | 1.1345 | 1.1101 | 1.1055 | 1.0842 | 1.0842 | 1.0803 | 1.0924 | 1.1055 | 1.1147 | 1.1244 (40) |
| HLP (average) | | | | | | | | | | | | 1.1100 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|-----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | (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 | (63) |
| Output from w/h | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 1411.7091 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | (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 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 15.2944 | 13.5843 | 11.0475 | 8.3637 | 6.2520 | 5.2782 | 5.7032 | 7.4133 | 9.9501 | 12.6339 | 14.7457 | 15.7195 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.5274 | 167.2450 | 162.9166 | 153.7018 | 142.0699 | 131.1375 | 123.8340 | 122.1163 | 126.4448 | 135.6595 | 147.2915 | 158.2238 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 297.8004 | 295.9706 | 285.2937 | 268.2150 | 251.1076 | 234.4667 | 223.5660 | 228.7143 | 237.4131 | 254.6729 | 274.4707 | 289.0954 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 37.2574 | (77) | | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 40.5522 | (77) | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7700 | 12.8629 | (81) | | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | (83) |
| Total gains | 388.4729 | 454.6920 | 513.8119 | 570.3821 | 606.9224 | 595.3456 | 568.3135 | 532.2706 | 491.2526 | 433.1537 | 383.8535 | 366.1887 | (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 | 24.2611 | 24.3739 | 24.4855 | 25.0237 | 25.1270 | 25.6195 | 25.6195 | 25.7129 | 25.4276 | 25.1270 | 24.9189 | 24.7049 | | |
| alpha | 2.6174 | 2.6249 | 2.6324 | 2.6682 | 2.6751 | 2.7080 | 2.7080 | 2.7142 | 2.6952 | 2.6751 | 2.6613 | 2.6470 | | |
| util living area | 0.9558 | 0.9334 | 0.8957 | 0.8243 | 0.7155 | 0.5705 | 0.4427 | 0.4830 | 0.6794 | 0.8571 | 0.9356 | 0.9614 | (86) | |
| MIT | 18.7422 | 19.0434 | 19.4935 | 20.0590 | 20.5150 | 20.8193 | 20.9337 | 20.9148 | 20.6918 | 20.0940 | 19.3355 | 18.7068 | (87) | |
| Th 2 | 19.9643 | 19.9686 | 19.9728 | 19.9926 | 19.9963 | 20.0137 | 20.0137 | 20.0169 | 20.0070 | 19.9963 | 19.9888 | 19.9810 | (88) | |
| util rest of house | 0.9494 | 0.9239 | 0.8805 | 0.7983 | 0.6722 | 0.5039 | 0.3553 | 0.3951 | 0.6180 | 0.8301 | 0.9248 | 0.9557 | (89) | |
| MIT 2 | 16.9567 | 17.3915 | 18.0370 | 18.8420 | 19.4583 | 19.8493 | 19.9699 | 19.9572 | 19.7041 | 18.9097 | 17.8302 | 16.9151 | (90) | |
| Living area fraction | fLA = Living area / (4) = | | | | | | | | | | | | 0.3138 | (91) |
| MIT | 17.5169 | 17.9098 | 18.4940 | 19.2238 | 19.7898 | 20.1537 | 20.2723 | 20.2576 | 20.0140 | 19.2813 | 18.3025 | 17.4772 | (92) | |
| Temperature adjustment | | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.3669 | 17.7598 | 18.3440 | 19.0738 | 19.6398 | 20.0037 | 20.1223 | 20.1076 | 19.8640 | 19.1313 | 18.1525 | 17.3272 | (93) | |

8. Space heating requirement

| | | | | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|---------|------|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
| | 0.9264 | 0.8965 | 0.8500 | 0.7702 | 0.6550 | 0.5032 | 0.3654 | 0.4037 | 0.6081 | 0.8015 | 0.8982 | 0.9346 | (94) | | |
| Useful gains | 359.8733 | 407.6400 | 436.7417 | 439.3337 | 397.5260 | 299.5740 | 207.6630 | 214.8715 | 298.7469 | 347.1634 | 344.7946 | 342.2290 | (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 | 853.9740 | 836.5501 | 766.9559 | 644.6351 | 501.0157 | 334.4257 | 217.9910 | 228.6272 | 359.4211 | 538.3382 | 703.2578 | 842.5040 | (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 | 367.6109 | 288.2275 | 245.6794 | 147.8170 | 76.9963 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 142.2340 | 258.0935 | 372.2046 | (98) | | |
| Space heating | | | | | | | | | | | | | 1898.8632 | (98) | |
| Space heating per m2 | | | | | | | | | | | | | (98) / (4) = | 33.2667 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 | (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 | (208) |
| Space heating requirement | | | | | | | | | | | | | 2098.1914 | (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Space heating requirement | 367.6109 | 288.2275 | 245.6794 | 147.8170 | 76.9963 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 142.2340 | 258.0935 | 372.2046 | 2098.1914 | (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | 406.1999 | 318.4835 | 271.4689 | 163.3337 | 85.0788 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.1646 | 285.1862 | 411.2758 | 2098.1914 | (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 | 0.0000 | (215) |
| Water heating requirement | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | (64) |
| Efficiency of water heater (217)m | 89.5788 | 89.5034 | 89.3625 | 89.0696 | 88.5789 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.0096 | 89.4085 | 87.3000 | 87.3000 | (216) |
| Fuel for water heating, kWh/month | 160.0264 | 140.5083 | 146.2566 | 129.4021 | 125.9532 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.3865 | 144.1432 | 155.4149 | 1591.2130 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1591.2130 | (219) |
| Annual totals kWh/year | | | | | | | | | | | | | 2098.1914 | (211) |
| Space heating fuel - main system | | | | | | | | | | | | | 0.0000 | (215) |
| Space heating fuel - secondary | | | | | | | | | | | | | 30.0000 | (230c) |
| Electricity for pumps and fans: | | | | | | | | | | | | | 45.0000 | (230e) |
| central heating pump | | | | | | | | | | | | | 75.0000 | (231) |
| main heating flue fan | | | | | | | | | | | | | 270.1038 | (232) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 4034.5082 | (238) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | 270.1038 | (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4034.5082 | (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 | 2098.1914 | 0.2160 | 453.2093 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1591.2130 | 0.2160 | 343.7020 (264) |
| Space and water heating | | | 796.9114 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total CO2, kg/year | | | 976.0202 (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 17.1000 (273) |

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

| | DER | TFA | N | EF | |
|---|-----|---------|--------|---------|-----|
| Total Floor Area | | 57.0800 | | | ZC1 |
| Assumed number of occupants | | 1.8980 | | | |
| CO2 emission factor in Table 12 for electricity displaced from grid | | | 0.5190 | | |
| CO2 emissions from appliances, equation (L14) | | | | 17.1843 | ZC2 |
| CO2 emissions from cooking, equation (L16) | | | | 2.8828 | ZC3 |
| Total CO2 emissions | | | | 37.1671 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP | | | | 0.0000 | ZC5 |
| Additional allowable electricity generation, kWh/m²/year | | | | 0.0000 | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | | | | 0.0000 | ZC7 |
| Net CO2 emissions | | | | 37.1671 | 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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) | | | | 20.0000 / (5) = | 0.1439 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | 0.3939 (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) = | | 0.3348 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| Effective ac | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | | | | | |
|---|-------------|-------------|-------------|---------------|----------------------|----------------|---------------|-------------|-------------|-------------|-------------|------------------|
| TER Opaque door | | | 1.9300 | 1.0000 | 1.9300 | | (26) | | | | | |
| TER Opening Type (Uw = 1.40) | | | 9.4500 | 1.3258 | 12.5284 | | (27) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1300 | 3.7102 | | (28a) | | | | | |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.1800 | 4.9518 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1300 | 3.7102 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 26.8306 | (33) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 250.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 7.0986 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 33.9292 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 27.1125 | Feb 26.9502 | Mar 26.7911 | Apr 26.0440 | May 25.9042 | Jun 25.2535 | Jul 25.2535 | Aug 25.1329 | Sep 25.5041 | Oct 25.9042 | Nov 26.1870 | Dec 26.4826 (38) |
| Heat transfer coeff | 61.0417 | 60.8794 | 60.7203 | 59.9732 | 59.8334 | 59.1827 | 59.1827 | 59.0622 | 59.4333 | 59.8334 | 60.1162 | 60.4118 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 59.9725 (39) |
| HLP | Jan 1.0694 | Feb 1.0666 | Mar 1.0638 | Apr 1.0507 | May 1.0482 | Jun 1.0368 | Jul 1.0368 | Aug 1.0347 | Sep 1.0412 | Oct 1.0482 | Nov 1.0532 | Dec 1.0584 (40) |
| HLP (average) | | | | | | | | | | | | 1.0507 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss: | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | 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 | | | | | | | | | | | | | 1973.4714 (211) |
| Space heating requirement | 382.1796 | 291.0197 | 232.0277 | 118.4862 | 41.5715 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 121.9724 | 262.7664 | 393.1987 | (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) | 409.1859 | 311.5843 | 248.4237 | 126.8589 | 44.5091 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.5915 | 281.3345 | 420.9837 | (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 | 173.7612 | 151.7849 | 157.9223 | 140.0692 | 135.6117 | 119.4392 | 114.4318 | 127.5647 | 128.9735 | 146.8620 | 156.7723 | 169.6806 | (64) |
| Efficiency of water heater (217)m | 86.9806 | 86.6636 | 86.0184 | 84.6332 | 82.4616 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 84.5878 | 86.3419 | 87.0976 | (216) |
| Fuel for water heating, kWh/month | 199.7701 | 175.1427 | 183.5913 | 165.5014 | 164.4543 | 148.7412 | 142.5054 | 158.8601 | 160.6145 | 173.6207 | 181.5716 | 194.8166 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 2049.1900 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 1973.4714 (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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4367.7652 (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 | 1973.4714 | 0.2160 | 426.2698 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 2049.1900 | 0.2160 | 442.6250 (264) |
| Space and water heating | | | 868.8949 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total CO2, kg/m2/year | | | 1048.0037 (272) |
| Emissions per m2 for space and water heating | | | 15.2224 (272a) |
| Fuel factor (mains gas) | | | 1.0000 |
| Emissions per m2 for lighting | | | 2.4559 (272b) |
| Emissions per m2 for pumps and fans | | | 0.6819 (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (15.2224 * 1.00) + 2.4559 + 0.6819, rounded to 2 d.p. | | | 18.3600 (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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) | | | | 20.0000 / (5) = | 0.1439 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | | 0.3939 (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) = | | 0.3348 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (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 |
|--|----------|-------------|------------|----------------------|-----------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.2700 | 7.4277 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 29.4918 | | (33) |
| Party Wall 1 | | | 69.6100 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1385 (36)
 Total fabric heat loss (33) + (36) = 34.6303 (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) | | | | | | | | | | | | |
| (38)m | 27.1125 | 26.9502 | 26.7911 | 26.0440 | 25.9042 | 25.2535 | 25.2535 | 25.1329 | 25.5041 | 25.9042 | 26.1870 | 26.4826 (38) |
| Heat transfer coeff | 61.7428 | 61.5805 | 61.4214 | 60.6743 | 60.5345 | 59.8838 | 59.8838 | 59.7632 | 60.1344 | 60.5345 | 60.8173 | 61.1129 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 60.6736 (39) |
| HLP | 1.0817 | 1.0788 | 1.0761 | 1.0630 | 1.0605 | 1.0491 | 1.0491 | 1.0470 | 1.0535 | 1.0605 | 1.0655 | 1.0707 (40) |
| HLP (average) | | | | | | | | | | | | 1.0630 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| 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) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | | | |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|------|
| 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 | (56) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Heat gains from water heating, kWh/month | 27.4810 | 24.0351 | 24.8021 | 21.6230 | 20.7478 | 17.9038 | 16.5905 | 19.0378 | 19.2652 | 22.4517 | 24.5078 | 26.6139 | | (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 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 15.2944 | 13.5843 | 11.0475 | 8.3637 | 6.2520 | 5.2782 | 5.7032 | 7.4133 | 9.9501 | 12.6339 | 14.7457 | 15.7195 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.5274 | 167.2450 | 162.9166 | 153.7018 | 142.0699 | 131.1375 | 123.8340 | 122.1163 | 126.4448 | 135.6595 | 147.2915 | 158.2238 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 36.9369 | 35.7665 | 33.3361 | 30.0320 | 27.8868 | 24.8664 | 22.2990 | 25.5885 | 26.7572 | 30.1771 | 34.0386 | 35.7714 | (72) |
| Total internal gains | 269.2285 | 268.0657 | 258.7700 | 243.5674 | 227.6785 | 212.7519 | 203.3061 | 206.5880 | 214.6220 | 229.9404 | 247.5456 | 261.1845 | (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 | | | | | |
|-------------|------------|--------------------------------|------------------------------|----------|------------------------------|----------|------------------------------|--------------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 36.7938 | 0.7100 | | 0.7000 | | 0.7700 | 37.2574 (77) | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | | 0.7000 | | 0.7700 | 40.5522 (77) | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | | 0.7000 | | 0.7700 | 12.8629 (81) | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | (83) |
| Total gains | 359.9010 | 426.7871 | 487.2882 | 545.7345 | 583.4934 | 573.6308 | 548.0537 | 510.1443 | 468.4615 | 408.4212 | 356.9285 | 338.2778 | (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 | 25.6800 | 25.7477 | 25.8144 | 26.1323 | 26.1926 | 26.4772 | 26.4772 | 26.5306 | 26.3669 | 26.1926 | 26.0708 | 25.9447 | |
| alpha | 2.7120 | 2.7165 | 2.7210 | 2.7422 | 2.7462 | 2.7651 | 2.7651 | 2.7687 | 2.7578 | 2.7462 | 2.7381 | 2.7296 | |
| util living area | 0.9617 | 0.9397 | 0.9018 | 0.8303 | 0.7198 | 0.5750 | 0.4456 | 0.4892 | 0.6879 | 0.8666 | 0.9432 | 0.9671 | (86) |
| MIT | 18.8041 | 19.1054 | 19.5508 | 20.0929 | 20.5382 | 20.8268 | 20.9375 | 20.9177 | 20.7000 | 20.1097 | 19.3598 | 18.7486 | (87) |
| Th 2 | 20.0158 | 20.0181 | 20.0204 | 20.0312 | 20.0332 | 20.0426 | 20.0426 | 20.0443 | 20.0390 | 20.0332 | 20.0291 | 20.0249 | (88) |
| util rest of house | 0.9562 | 0.9311 | 0.8877 | 0.8053 | 0.6777 | 0.5098 | 0.3600 | 0.4028 | 0.6283 | 0.8414 | 0.9337 | 0.9623 | (89) |
| MIT 2 | 18.0083 | 18.3058 | 18.7423 | 19.2699 | 19.6811 | 19.9341 | 20.0139 | 20.0043 | 19.8356 | 19.2987 | 18.5684 | 17.9600 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | | 0.3138 (91) |
| MIT | 18.2580 | 18.5567 | 18.9960 | 19.5282 | 19.9500 | 20.2142 | 20.3037 | 20.2909 | 20.1068 | 19.5531 | 18.8167 | 18.2074 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.2580 | 18.5567 | 18.9960 | 19.5282 | 19.9500 | 20.2142 | 20.3037 | 20.2909 | 20.1068 | 19.5531 | 18.8167 | 18.2074 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------------|--------------|
| Utilisation | 0.9432 | 0.9152 | 0.8699 | 0.7906 | 0.6738 | 0.5222 | 0.3843 | 0.4261 | 0.6328 | 0.8266 | 0.9187 | 0.9505 | (94) | |
| Useful gains | 339.4714 | 390.5790 | 423.9160 | 431.4594 | 393.1474 | 299.5334 | 210.5989 | 217.3773 | 296.4658 | 337.6076 | 327.9058 | 321.5247 | (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 | 861.8057 | 840.9852 | 767.5203 | 644.8556 | 499.4122 | 336.1984 | 221.7927 | 232.5345 | 361.2142 | 541.9738 | 712.5764 | 856.0335 | (97) | |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) | |
| Space heating kWh | 388.6168 | 302.6729 | 255.6416 | 153.6453 | 79.0610 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 152.0484 | 276.9628 | 397.6746 | (98) | |
| Space heating per m2 | | | | | | | | | | | | 2006.3234 | (98) | |
| | | | | | | | | | | | | | (98) / (4) = | 35.1493 (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 | 562.9073 | 443.1398 | 454.2007 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (100) |
| Utilisation | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.8260 | 0.8773 | 0.8562 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (101) |
| Useful loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 464.9750 | 388.7529 | 388.9042 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (102) |
| Total gains | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 741.8417 | 710.5814 | 667.4368 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103) |
| Month fracti | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (103a) |
| Space cooling kWh | | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



SAINT-GOBAIN INSULATION UK

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | |
|--|--------|--------|--------|--------|--------|----------|----------|----------|--------|--------|--------|----------------|
| Space cooling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.3440 | 239.4404 | 207.2283 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) |
| Cooled fraction | | | | | | | | | | | | 646.0127 (104) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | 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 | 49.8360 | 59.8601 | 51.8071 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) |
| Space cooling per m2 | | | | | | | | | | | | 161.5032 (107) |
| Energy for space heating | | | | | | | | | | | | 2.8294 (108) |
| Energy for space cooling | | | | | | | | | | | | 35.1493 (99) |
| Total | | | | | | | | | | | | 2.8294 (108) |
| Dwelling Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 37.9787 (109) |
| | | | | | | | | | | | | 38.0 (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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) | | | | 20.0000 / (5) = | 0.1439 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | 0.3939 (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) = | | 0.3348 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| Effective ac | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | | | | | |
|---|-------------|-------------|-------------|---------------|----------------------|----------------|---------------|-------------|-------------|-------------|-------------|------------------|
| TER Opaque door | | | 1.9300 | 1.0000 | 1.9300 | | (26) | | | | | |
| TER Opening Type (Uw = 1.40) | | | 9.4500 | 1.3258 | 12.5284 | | (27) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1300 | 3.7102 | | (28a) | | | | | |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.1800 | 4.9518 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1300 | 3.7102 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 26.8306 | (33) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 250.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 7.0986 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 33.9292 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 27.1125 | Feb 26.9502 | Mar 26.7911 | Apr 26.0440 | May 25.9042 | Jun 25.2535 | Jul 25.2535 | Aug 25.1329 | Sep 25.5041 | Oct 25.9042 | Nov 26.1870 | Dec 26.4826 (38) |
| Heat transfer coeff | 61.0417 | 60.8794 | 60.7203 | 59.9732 | 59.8334 | 59.1827 | 59.1827 | 59.0622 | 59.4333 | 59.8334 | 60.1162 | 60.4118 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 59.9725 (39) |
| HLP | Jan 1.0694 | Feb 1.0666 | Mar 1.0638 | Apr 1.0507 | May 1.0482 | Jun 1.0368 | Jul 1.0368 | Aug 1.0347 | Sep 1.0412 | Oct 1.0482 | Nov 1.0532 | Dec 1.0584 (40) |
| HLP (average) | | | | | | | | | | | | 1.0507 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (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 | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | |
|--|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|--------|----------------|
| Intermittency factor (Table 10b) | 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 | 32.6273 | 45.3024 | 37.5059 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling | | | | | | | | | | | | 115.4356 (107) |
| Space cooling per m2 | | | | | | | | | | | | 2.0223 (108) |
| Energy for space heating | | | | | | | | | | | | 36.0572 (99) |
| Energy for space cooling | | | | | | | | | | | | 2.0223 (108) |
| Total | | | | | | | | | | | | 38.0795 (109) |
| Target Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 43.8 (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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-----------------------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.5378 (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) = | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|----------------------|-----------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.2700 | 7.4277 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 29.4918 | | (33) |
| Party Wall 1 | | | 69.6100 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1385 (36)
 Total fabric heat loss (33) + (36) = 34.6303 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 64.7549 | 63.9013 | 64.1798 | 63.1016 | 63.1016 | 61.8885 | 61.8885 | 61.6639 | 61.8885 | 63.1016 | 63.1016 | 63.9013 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.0394 (39) |
| HLP | 1.1345 | 1.1195 | 1.1244 | 1.1055 | 1.1055 | 1.0842 | 1.0842 | 1.0803 | 1.0842 | 1.1055 | 1.1055 | 1.1195 (40) |
| HLP (average) | | | | | | | | | | | | 1.1044 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) | |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | (57) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (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 | 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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (64) |
| RHI water heating demand | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (73) |

6. Solar gains

| | | | | | | | | | | | | |
|-------------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| [Jan] | Area m2 | Solar flux Table 6a W/m2 | Specific data g or Table 6b | Specific data FF or Table 6c | Access factor Table 6d | Gains W | | | | | | |
| Southeast | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 (77) | | | | | | |
| Southeast | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 (77) | | | | | | |
| Northwest | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 (81) | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 (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 | 24.4855 | 24.8126 | 24.7049 | 25.1270 | 25.1270 | 25.6195 | 25.6195 | 25.7129 | 25.6195 | 25.1270 | 25.1270 | 24.8126 | |
| alpha | 2.6324 | 2.6542 | 2.6470 | 2.6751 | 2.6751 | 2.7080 | 2.7080 | 2.7142 | 2.7080 | 2.6751 | 2.6751 | 2.6542 | |
| util living area | 0.9048 | 0.8788 | 0.8269 | 0.7368 | 0.6210 | 0.4571 | 0.3628 | 0.3773 | 0.5613 | 0.7617 | 0.9150 | 0.9141 | (86) |
| MIT | 19.2676 | 19.4941 | 19.8824 | 20.3402 | 20.6815 | 20.9022 | 20.9603 | 20.9567 | 20.8211 | 20.3888 | 19.5639 | 19.2294 | (87) |
| Th 2 | 19.9728 | 19.9849 | 19.9810 | 19.9963 | 19.9963 | 20.0137 | 20.0137 | 20.0169 | 20.0137 | 19.9963 | 19.9963 | 19.9849 | (88) |
| util rest of house | 0.8921 | 0.8633 | 0.8047 | 0.7038 | 0.5725 | 0.3927 | 0.2857 | 0.2979 | 0.4971 | 0.7238 | 0.9008 | 0.9025 | (89) |
| MIT 2 | 17.7103 | 18.0368 | 18.5789 | 19.2142 | 19.6591 | 19.9314 | 19.9889 | 19.9897 | 19.8489 | 19.2958 | 18.1603 | 17.6645 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3138 | (91) |
| MIT | 18.1989 | 18.4941 | 18.9879 | 19.5675 | 19.9799 | 20.2360 | 20.2937 | 20.2931 | 20.1539 | 19.6387 | 18.6007 | 18.1555 | (92) |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 18.0489 | 18.3441 | 18.8379 | 19.4175 | 19.8299 | 20.0860 | 20.1437 | 20.1431 | 20.0039 | 19.4887 | 18.4507 | 18.0055 | (93) |

8. Space heating requirement

| | | | | | | | | | | | | | |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Useful gains | 468.7151 | 499.4784 | 510.6891 | 491.7305 | 413.1944 | 296.4078 | 207.1212 | 205.7480 | 311.8584 | 398.5156 | 363.3633 | 448.1382 | (94) |
| Ext temp. | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 | (96) |
| Heat loss rate W | 851.4579 | 833.5329 | 759.7515 | 638.4325 | 481.4573 | 314.7654 | 213.1272 | 212.3153 | 346.8185 | 529.3431 | 672.0768 | 837.4609 | (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 | 284.7606 | 224.4846 | 185.3024 | 105.6254 | 50.7876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 97.3357 | 222.2737 | 289.6561 | (98) |
| Space heating | | | | | | | | | | | | 1460.2262 | (98) |
| RHI space heating demand | | | | | | | | | | | | 1460 | (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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-------|-----------------------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | | Yes |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.5378 (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) = | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 |
|--|----------|-------------|------------|----------------------|-----------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.2700 | 7.4277 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 29.4918 | | (33) |
| Party Wall 1 | | | 69.6100 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1385 (36)
 Total fabric heat loss (33) + (36) = 34.6303 (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) | | | | | | | | | | | | |
| (38)m | 30.7236 | 30.4211 | 30.1246 | 28.7318 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.7255 | 28.4713 | 28.9984 | 29.5495 (38) |
| Heat transfer coeff | 65.3539 | 65.0514 | 64.7549 | 63.3621 | 63.1016 | 61.8885 | 61.8885 | 61.6639 | 62.3558 | 63.1016 | 63.6287 | 64.1798 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.3609 (39) |
| HLP | 1.1450 | 1.1397 | 1.1345 | 1.1101 | 1.1055 | 1.0842 | 1.0842 | 1.0803 | 1.0924 | 1.1055 | 1.1147 | 1.1244 (40) |
| HLP (average) | | | | | | | | | | | | 1.1100 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|----------|--------------------------|---------------------------|-----------------------------|------------------------------|------------------------|----------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7000 | 0.7700 | 37.2574 | (77) | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7000 | 0.7700 | 40.5522 | (77) | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7000 | 0.7700 | 12.8629 | (81) | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | (83) |
| Total gains | 527.7187 | 592.2188 | 645.4015 | 693.4074 | 721.0509 | 702.6288 | 672.6371 | 638.3133 | 603.2324 | 553.6979 | 513.2945 | 502.4750 | (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) | 24.2611 | 24.3739 | 24.4855 | 25.0237 | 25.1270 | 25.6195 | 25.6195 | 25.7129 | 25.4276 | 25.1270 | 24.9189 | 24.7049 | 21.0000 | (85) |
| tau | 2.6174 | 2.6249 | 2.6324 | 2.6682 | 2.6751 | 2.7080 | 2.7080 | 2.7142 | 2.6952 | 2.6751 | 2.6613 | 2.6470 | | |
| util living area | 0.9169 | 0.8886 | 0.8433 | 0.7628 | 0.6494 | 0.5046 | 0.3833 | 0.4156 | 0.5979 | 0.7864 | 0.8858 | 0.9246 | (86) | |
| MIT | 19.0951 | 19.3632 | 19.7580 | 20.2455 | 20.6230 | 20.8669 | 20.9535 | 20.9412 | 20.7778 | 20.2981 | 19.6382 | 19.0621 | (87) | |
| Th 2 | 19.9643 | 19.9686 | 19.9728 | 19.9926 | 19.9963 | 20.0137 | 20.0137 | 20.0169 | 20.0070 | 19.9963 | 19.9888 | 19.9810 | (88) | |
| util rest of house | 0.9059 | 0.8743 | 0.8231 | 0.7323 | 0.6039 | 0.4410 | 0.3046 | 0.3360 | 0.5356 | 0.7523 | 0.8689 | 0.9146 | (89) | |
| MIT 2 | 17.4585 | 17.8410 | 18.4002 | 19.0858 | 19.5863 | 19.8954 | 19.9838 | 19.9769 | 19.7953 | 19.1752 | 18.2527 | 17.4219 | (90) | |
| Living area fraction | 17.9720 | 18.3186 | 18.8263 | 19.4497 | 19.9116 | 20.2003 | 20.2881 | 20.2794 | 20.1036 | 19.5275 | 18.6874 | 17.9366 | (92) | |
| MIT | 17.9720 | 18.3186 | 18.8263 | 19.4497 | 19.9116 | 20.2003 | 20.2881 | 20.2794 | 20.1036 | 19.5275 | 18.6874 | 17.9366 | (92) | |
| Temperature adjustment | | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.8220 | 18.1686 | 18.6763 | 19.2997 | 19.7616 | 20.0503 | 20.1381 | 20.1294 | 19.9536 | 19.3775 | 18.5374 | 17.7866 | (93) | |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Useful gains | 462.4718 | 499.3655 | 511.6235 | 491.3472 | 427.1560 | 311.5742 | 211.7823 | 220.5483 | 320.8944 | 403.1013 | 430.4953 | 445.3254 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate W | 883.7160 | 863.1407 | 788.4723 | 658.9452 | 508.7006 | 337.3086 | 218.9648 | 229.9718 | 365.0036 | 553.8737 | 727.7482 | 871.9830 | (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 | 313.4057 | 244.4569 | 205.9756 | 120.6705 | 60.6692 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 112.1746 | 214.0221 | 317.4332 | (98) |
| Space heating | | | | | | | | | | | | 1588.8079 | (98) |
| Space heating per m2 | | | | | | | | | | | | 27.8348 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

| | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 1755.5888 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 313.4057 | 244.4569 | 205.9756 | 120.6705 | 60.6692 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 112.1746 | 214.0221 | 317.4332 | (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | 346.3046 | 270.1182 | 227.5973 | 133.3376 | 67.0378 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 123.9498 | 236.4885 | 350.7549 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) |
| Efficiency of water heater (217)m | 89.4707 | 89.3870 | 89.2303 | 88.9079 | 88.4010 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 88.8199 | 89.2702 | 87.3000 | (216) |
| Fuel for water heating, kWh/month | 160.2197 | 140.6912 | 146.4734 | 129.6375 | 126.2066 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.6735 | 144.3666 | 155.5991 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1592.9895 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 1755.5888 (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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 3693.6821 (238) |

10a. Fuel costs - using Table 12 prices

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|-------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 1755.5888 | 3.4800 | 61.0945 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 1592.9895 | 3.4800 | 55.4360 (247) |
| Pumps and fans for heating | 75.0000 | 13.1900 | 9.8925 (249) |
| Energy for lighting | 270.1038 | 13.1900 | 35.6267 (250) |
| Additional standing charges | | | 120.0000 (251) |
| Total energy cost | | | 282.0497 (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|---|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | $[(255) \times (256)] / [(4) + 45.0] =$ | 1.1605 (257) |
| SAP value | | 83.8114 |
| SAP rating (Section 12) | | 84 (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 | 1755.5888 | 0.2160 | 379.2072 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1592.9895 | 0.2160 | 344.0857 (264) |
| Space and water heating | | | 723.2929 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total kg/year | | | 902.4018 (272) |
| CO2 emissions per m2 | | | 15.8100 (273) |
| EI value | | | 88.1542 |
| EI rating | | | 88 (274) |
| EI band | | | B |

Calculation of stars for heating and DHW

| | |
|------------------------------------|---|
| Main heating energy efficiency | $3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4 |
| Main heating environmental impact | $0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4 |
| Water heating energy efficiency | $3.48 / 0.8852 = 3.932$, stars = 4 |
| Water heating environmental impact | $0.216 / 0.8852 = 0.2440$, 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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | 5.0000 |
| Measured/design AP50 | | | | | 0.5378 (18) |
| Infiltration rate | | | | | 2 (19) |
| Number of sides sheltered | | | | | |
| Shelter factor | | | (20) = 1 - [0.075 x (19)] = | | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | | | (21) = (18) x (20) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|----------------------|-----------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.2700 | 7.4277 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 29.4918 | | (33) |
| Party Wall 1 | | | 69.6100 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1385 (36)
 Total fabric heat loss (33) + (36) = 34.6303 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 64.7549 | 63.9013 | 64.1798 | 63.1016 | 63.1016 | 61.8885 | 61.8885 | 61.6639 | 61.8885 | 63.1016 | 63.1016 | 63.9013 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.0394 (39) |
| HLP | 1.1345 | 1.1195 | 1.1244 | 1.1055 | 1.1055 | 1.0842 | 1.0842 | 1.0803 | 1.0842 | 1.1055 | 1.1055 | 1.1195 (40) |
| HLP (average) | | | | | | | | | | | | 1.1044 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Water storage loss: | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) | |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63) |
| Output from w/h | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | (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) |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| (66)m | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (73) |

6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | Specific data g or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | (77) | | | | | | |
|-------------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|----------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 | (77) | | | | | | |
| Southeast | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 | (77) | | | | | | |
| Northwest | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 | (81) | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 | (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 | (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 | (85) |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| Utilisation factor for gains for living area, nil,m (see Table 9a) | 24.4855 | 24.8126 | 24.7049 | 25.1270 | 25.1270 | 25.6195 | 25.6195 | 25.7129 | 25.6195 | 25.1270 | 25.1270 | 24.8126 | (85) |
| alpha | 2.6324 | 2.6542 | 2.6470 | 2.6751 | 2.6751 | 2.7080 | 2.7080 | 2.7142 | 2.7080 | 2.6751 | 2.6751 | 2.6542 | (86) |
| util living area | 0.9048 | 0.8788 | 0.8269 | 0.7368 | 0.6210 | 0.4571 | 0.3628 | 0.3773 | 0.5613 | 0.7617 | 0.9150 | 0.9141 | (86) |
| MIT | 19.2676 | 19.4941 | 19.8824 | 20.3402 | 20.6815 | 20.9022 | 20.9603 | 20.9567 | 20.8211 | 20.3888 | 19.5639 | 19.2294 | (87) |
| Th 2 | 19.9728 | 19.9849 | 19.9810 | 19.9963 | 19.9963 | 20.0137 | 20.0137 | 20.0169 | 20.0137 | 19.9963 | 19.9963 | 19.9849 | (88) |
| util rest of house | 0.8921 | 0.8633 | 0.8047 | 0.7038 | 0.5725 | 0.3927 | 0.2857 | 0.2979 | 0.4971 | 0.7238 | 0.9008 | 0.9025 | (89) |
| MIT 2 | 17.7103 | 18.0368 | 18.5789 | 19.2142 | 19.6591 | 19.9314 | 19.9889 | 19.9897 | 19.8489 | 19.2958 | 18.1603 | 17.6645 | (90) |
| Living area fraction | 18.1989 | 18.4941 | 18.9879 | 19.5675 | 19.9799 | 20.2360 | 20.2937 | 20.2931 | 20.1539 | 19.6387 | 18.6007 | 18.1555 | (92) |
| MIT | 18.1989 | 18.4941 | 18.9879 | 19.5675 | 19.9799 | 20.2360 | 20.2937 | 20.2931 | 20.1539 | 19.6387 | 18.6007 | 18.1555 | (92) |
| Temperature adjustment | 18.0489 | 18.3441 | 18.8379 | 19.4175 | 19.8299 | 20.0860 | 20.1437 | 20.1431 | 20.0039 | 19.4887 | 18.4507 | 18.0055 | (93) |
| adjusted MIT | 18.0489 | 18.3441 | 18.8379 | 19.4175 | 19.8299 | 20.0860 | 20.1437 | 20.1431 | 20.0039 | 19.4887 | 18.4507 | 18.0055 | (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | (94) |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Useful gains | 468.7151 | 499.4784 | 510.6891 | 491.7305 | 413.1944 | 296.4078 | 207.1212 | 205.7480 | 311.8584 | 398.5156 | 363.3633 | 448.1382 | (95) |
| Ext temp. | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 | (96) |
| Heat loss rate W | 851.4579 | 833.5329 | 759.7515 | 638.4325 | 481.4573 | 314.7654 | 213.1272 | 212.3153 | 346.8185 | 529.3431 | 672.0768 | 837.4609 | (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 | 284.7606 | 224.4846 | 185.3024 | 105.6254 | 50.7876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 97.3357 | 222.2737 | 289.6561 | (98) |
| Space heating | | | | | | | | | | | | 1460.2262 | (98) |
| Space heating per m2 | | | | | | | | | | | | 25.5821 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 | (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 | (208) |
| Space heating requirement | | | | | | | | | | | | | 1613.5096 | (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Space heating requirement | 284.7606 | 224.4846 | 185.3024 | 105.6254 | 50.7876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 97.3357 | 222.2737 | 289.6561 | (98) | |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) | |
| Space heating fuel (main heating system) | 314.6526 | 248.0493 | 204.7540 | 116.7132 | 56.1189 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 107.5533 | 245.6063 | 320.0620 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) | |
| Efficiency of water heater (217)m | 89.4027 | 89.3244 | 89.1485 | 88.8015 | 88.2764 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 88.7072 | 89.2987 | 87.3000 | (216) | |
| Fuel for water heating, kWh/month | 160.3416 | 140.7899 | 146.6078 | 129.7928 | 126.3848 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.8445 | 144.3205 | 155.7105 | (219) | |
| Water heating fuel used | | | | | | | | | | | | | 1593.9143 | (219) |
| Annual totals kWh/year | | | | | | | | | | | | | 1613.5096 | (211) |
| Space heating fuel - main system | | | | | | | | | | | | | 0.0000 | (215) |
| Space heating fuel - secondary | | | | | | | | | | | | | 30.0000 | (230c) |
| Electricity for pumps and fans: | | | | | | | | | | | | | 45.0000 | (230e) |
| central heating pump | | | | | | | | | | | | | 75.0000 | (231) |
| main heating flue fan | | | | | | | | | | | | | 270.1038 | (232) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 3552.5278 | (238) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | | |
| Total delivered energy for all uses | | | | | | | | | | | | | | |

10a. Fuel costs - using BEDF prices (485)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|-------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 1613.5096 | 3.7400 | 60.3453 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 1593.9143 | 3.7400 | 59.6124 (247) |
| Pumps and fans for heating | 75.0000 | 19.1200 | 14.3400 (249) |
| Energy for lighting | 270.1038 | 19.1200 | 51.6438 (250) |
| Additional standing charges | | | 94.0000 (251) |
| Total energy cost | | | 279.9415 (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 | 1613.5096 | 0.2160 | 348.5181 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1593.9143 | 0.2160 | 344.2855 (264) |
| Space and water heating | | | 692.8036 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total kg/year | | | 871.9124 (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 | 1613.5096 | 1.2200 | 1968.4818 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1593.9143 | 1.2200 | 1944.5754 (264) |
| Space and water heating | | | 3913.0572 (265) |
| Pumps and fans | 75.0000 | 3.0700 | 230.2500 (267) |
| Energy for lighting | 270.1038 | 3.0700 | 829.2187 (268) |
| Primary energy kWh/year | | | 4972.5259 (272) |
| Primary energy kWh/m2/year | | | 87.1150 (273) |

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
 Current environmental impact rating: B 88

(For testing purposes):

A Not considered
 B Not considered

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | |
|----|---------------------------|-------------------|
| 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 | Recommended |
| 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 | + 1.4 | -£ 23 | -162 kg (18.6%) |
| U Solar photovoltaic panels | + 13.1 | -£ 349 | -946 kg (133.3%) |

| Recommended measures | Typical annual savings | | Energy efficiency | Environmental impact |
|---------------------------|------------------------|-------------------------------|-------------------|----------------------|
| Solar water heating | £23 | 2.84 kg/m ² | B 85 | B 90 |
| Solar photovoltaic panels | £349 | 16.58 kg/m ² | A 98 | A 102 |
| Total Savings | £372 | 19.42 kg/m² | | |

Potential energy efficiency rating: A 98
 Potential environmental impact rating: A 102

Fuel prices for cost data on this page from database revision number 485 TEST (29 Oct 2021)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

| | Current | Potential | Saving |
|----------------------------------|-----------------------|------------------------|------------------------|
| Electricity | £66 | £76 | -£10 |
| Mains gas | £214 | £181 | £33 |
| Space heating | £169 | £169 | £0 |
| Water heating | £60 | £37 | £23 |
| Lighting | £52 | £52 | £0 |
| Generated (PV) | -£0 | -£349 | £349 |
| Total cost of fuels | £280 | -£92 | £372 |
| Total cost of uses | £281 | -£91 | £372 |
| Delivered energy | 62 kWh/m ² | 16 kWh/m ² | 46 kWh/m ² |
| Carbon dioxide emissions | 0.9 tonnes | -0.2 tonnes | 1.1 tonnes |
| CO2 emissions per m ² | 15 kg/m ² | -4 kg/m ² | 19 kg/m ² |
| Primary energy | 87 kWh/m ² | -27 kWh/m ² | 114 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 (m2) | Storey height (m) | Volume (m3) |
|--|--------------|---------------------------------|-----------------------|
| Ground floor | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 |
|--|----------|-------------|------------|----------------------|-----------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.2700 | 7.4277 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 29.4918 | | (33) |
| Party Wall 1 | | | 69.6100 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1385 (36)
 Total fabric heat loss (33) + (36) = 34.6303 (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) | | | | | | | | | | | | |
| (38)m | 30.7236 | 30.4211 | 30.1246 | 28.7318 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.7255 | 28.4713 | 28.9984 | 29.5495 (38) |
| Heat transfer coeff | 65.3539 | 65.0514 | 64.7549 | 63.3621 | 63.1016 | 61.8885 | 61.8885 | 61.6639 | 62.3558 | 63.1016 | 63.6287 | 64.1798 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.3609 (39) |
| HLP | 1.1450 | 1.1397 | 1.1345 | 1.1101 | 1.1055 | 1.0842 | 1.0842 | 1.0803 | 1.0924 | 1.1055 | 1.1147 | 1.1244 (40) |
| HLP (average) | | | | | | | | | | | | 1.1100 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation | 0.8764 | 0.8432 | 0.7927 | 0.7086 | 0.5924 | 0.4434 | 0.3149 | 0.3455 | 0.5320 | 0.7280 | 0.8387 | 0.8863 (94) |
| Useful gains | 462.4718 | 499.3655 | 511.6235 | 491.3472 | 427.1560 | 311.5742 | 211.7823 | 220.5483 | 320.8944 | 403.1013 | 430.4953 | 445.3254 (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 | | | | | | | | | | | | |
| Month fracti | 883.7160 | 863.1407 | 788.4723 | 658.9452 | 508.7006 | 337.3086 | 218.9648 | 229.9718 | 365.0036 | 553.8737 | 727.7482 | 871.9830 (97) |
| Space heating kWh | 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 | 313.4057 | 244.4569 | 205.9756 | 120.6705 | 60.6692 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 112.1746 | 214.0221 | 317.4332 (98) |
| Space heating per m2 | | | | | | | | | | | | 1588.8079 (98) |
| | | | | | | | | | | | | (98) / (4) = 27.8348 (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) | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | 1755.5888 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating requirement | 313.4057 | 244.4569 | 205.9756 | 120.6705 | 60.6692 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 112.1746 | 214.0221 | 317.4332 (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 (210) |
| Space heating fuel (main heating system) | 346.3046 | 270.1182 | 227.5973 | 133.3376 | 67.0378 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 123.9498 | 236.4885 | 350.7549 (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 | 120.6081 | 87.8104 | 66.0667 | 28.6385 | 4.5569 | 0.0000 | 0.0000 | 12.7998 | 33.1000 | 71.1038 | 101.9015 | 120.2297 (64) |
| Efficiency of water heater (217)m | 89.5875 | 89.6317 | 89.7015 | 89.8682 | 90.2688 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.2311 | 89.4425 | 89.5978 (217) |
| Fuel for water heating, kWh/month | 134.6261 | 97.9680 | 73.6518 | 31.8673 | 5.0482 | 0.0000 | 0.0000 | 14.6619 | 37.9153 | 79.6850 | 113.9296 | 134.1883 (219) |
| Water heating fuel used | | | | | | | | | | | | 723.5413 (219) |
| Annual totals kWh/year | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | 1755.5888 (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) |
| pump for solar water heating | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 125.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 270.1038 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = | | | | | | | | | | -1727.2394 | | -1727.2394 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | 1146.9945 (238) |

10a. Fuel costs - using Table 12 prices

| | | | |
|---------------------------------------|---------------|------------------|------------------|
| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
| Space heating - main system 1 | 1755.5888 | 3.4800 | 61.0945 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 723.5413 | 3.4800 | 25.1792 (247) |
| 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 | 270.1038 | 13.1900 | 35.6267 (250) |
| Additional standing charges | | | 120.0000 (251) |
| Energy saving/generation technologies | | | |
| PV Unit | -1727.2394 | 13.1900 | -227.8229 (252) |
| Total energy cost | | | 30.5650 (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|----------------------------------|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | [(255) x (256)] / [(4) + 45.0] = | 0.1258 (257) |
| SAP value | | 98.2457 |
| SAP rating (Section 12) | | 98 (258) |
| SAP band | | A |

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 | 1755.5888 | 0.2160 | 379.2072 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 723.5413 | 0.2160 | 156.2849 (264) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | |
|---------------------------------------|------------|--------|-----------------|
| Space and water heating | | | 535.4921 (265) |
| Pumps and fans | 125.0000 | 0.5190 | 64.8750 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1727.2394 | 0.5190 | -896.4372 (269) |
| Total kg/year | | | -155.8863 (272) |
| CO2 emissions per m2 | | | -2.7300 (273) |
| EI value | | | 102.0463 |
| EI rating | | | 102 (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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | | Yes |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|----------------------|-----------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 38.8900 | 11.3800 | 27.5100 | 0.2700 | 7.4277 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 95.9700 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 29.4918 | | (33) |
| Party Wall 1 | | | 69.6100 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.1385 (36)
 Total fabric heat loss (33) + (36) = 34.6303 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 64.7549 | 63.9013 | 64.1798 | 63.1016 | 63.1016 | 61.8885 | 61.8885 | 61.6639 | 61.8885 | 63.1016 | 63.1016 | 63.9013 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 63.0394 (39) |
| HLP | 1.1345 | 1.1195 | 1.1244 | 1.1055 | 1.1055 | 1.0842 | 1.0842 | 1.0803 | 1.0842 | 1.1055 | 1.1055 | 1.1195 (40) |
| HLP (average) | | | | | | | | | | | | 1.1044 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------|-----------------|
| 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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) | | |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | 14.0187 | (57) | |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | 139.2606 | (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 | | | | | | | | | | | | | | | | | | | | | | | | | | 1139.7099 (H5) |
| Overshading factor | | | | | | | | | | | | | | | | | | | | | | | | | | 0.8000 (H6) |
| Solar energy available | | | | | | | | | | | | | | | | | | | | | | | | | | 1914.7126 (H7) |
| Adjustment factor for showers | | | | | | | | | | | | | | | | | | | | | | | | | | 1.0000 (H7a) |
| Solar-to-load ratio | | | | | | | | | | | | | | | | | | | | | | | | | | 1.5350 (H8) |
| Utilisation factor | | | | | | | | | | | | | | | | | | | | | | | | | | 0.4787 (H9) |
| Collector performance factor | | | | | | | | | | | | | | | | | | | | | | | | | | 0.8793 (H10) |
| Dedicated solar storage volume | | | | | | | | | | | | | | | | | | | | | | | | | | 75.0000 (H11) |
| Effective solar volume | | | | | | | | | | | | | | | | | | | | | | | | | | 75.0000 (H13) |
| Daily hot water demand | | | | | | | | | | | | | | | | | | | | | | | | | | 79.2773 (H14) |
| Volume ratio Veff/V | | | | | | | | | | | | | | | | | | | | | | | | | | 0.9460 (H15) |
| Solar storage volume factor | | | | | | | | | | | | | | | | | | | | | | | | | | 0.9889 (H16) |
| Solar input | | | | | | | | | | | | | | | | | | | | | | | | | | -797.0145 (H17) |
| Solar input | -26.1366 | -38.8057 | -66.4777 | -91.2580 | -106.5291 | -113.2936 | -107.7339 | -95.8834 | -75.7071 | -50.9881 | -3.0549 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | -21.1463 | (63) |
| Solar input (sum of months) = Sum (63)m = | | | | | | | | | | | | | | | | | | | | | | | | | | -797.0145 (63) |
| Output from w/h | 117.2131 | 86.9540 | 64.2209 | 24.0000 | 5.0389 | 0.0000 | 0.0000 | 7.6232 | 28.4345 | 68.6287 | 125.8214 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | 118.1143 | (64) |
| Total per year (kWh/year) = Sum (64)m = | | | | | | | | | | | | | | | | | | | | | | | | | | 646.0488 (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | 39.2987 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | 236.1550 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 (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 | 3.0000 (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | 60.6823 (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | 425.3817 (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 | | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|----------|---------------|
| Southeast | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 (77) | | | | | | | |
| Southeast | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 (77) | | | | | | | |
| Northwest | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 (81) | | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 | 87.7686 (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 | 513.1503 (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 | 24.4855 | 24.8126 | 24.7049 | 25.1270 | 25.1270 | 25.6195 | 25.6195 | 25.7129 | 25.6195 | 25.1270 | 25.1270 | 24.8126 | 24.8126 | |
| alpha | 2.6324 | 2.6542 | 2.6470 | 2.6751 | 2.6751 | 2.7080 | 2.7080 | 2.7142 | 2.7080 | 2.6751 | 2.6751 | 2.6542 | 2.6542 | |
| util living area | 0.9048 | 0.8788 | 0.8269 | 0.7368 | 0.6210 | 0.4571 | 0.3628 | 0.3773 | 0.5613 | 0.7617 | 0.9150 | 0.9141 | 0.9141 (86) | |
| MIT | 19.2676 | 19.4941 | 19.8824 | 20.3402 | 20.6815 | 20.9022 | 20.9603 | 20.9567 | 20.8211 | 20.3888 | 19.5639 | 19.2294 | 19.2294 (87) | |
| Th 2 | 19.9728 | 19.9849 | 19.9810 | 19.9963 | 19.9963 | 20.0137 | 20.0137 | 20.0169 | 20.0137 | 19.9963 | 19.9963 | 19.9849 | 19.9849 (88) | |
| util rest of house | 0.8921 | 0.8633 | 0.8047 | 0.7038 | 0.5725 | 0.3927 | 0.2857 | 0.2979 | 0.4971 | 0.7238 | 0.9008 | 0.9025 | 0.9025 (89) | |
| MIT 2 | 17.7103 | 18.0368 | 18.5789 | 19.2142 | 19.6591 | 19.9314 | 19.9889 | 19.9897 | 19.8489 | 19.2958 | 18.1603 | 17.6645 | 17.6645 (90) | |
| Living area fraction | | | | | | | | | | | | | | 0.3138 (91) |
| MIT | 18.1989 | 18.4941 | 18.9879 | 19.5675 | 19.9799 | 20.2360 | 20.2937 | 20.2931 | 20.1539 | 19.6387 | 18.6007 | 18.1555 | 18.1555 (92) | |
| Temperature adjustment | | | | | | | | | | | | | | -0.1500 |
| adjusted MIT | 18.0489 | 18.3441 | 18.8379 | 19.4175 | 19.8299 | 20.0860 | 20.1437 | 20.1431 | 20.0039 | 19.4887 | 18.4507 | 18.0055 | 18.0055 (93) | |

8. Space heating requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation | 0.8619 | 0.8326 | 0.7754 | 0.6826 | 0.5639 | 0.3976 | 0.2961 | 0.3084 | 0.4965 | 0.7020 | 0.8722 | 0.8733 (94) |
| Useful gains | 468.7151 | 499.4784 | 510.6891 | 491.7305 | 413.1944 | 296.4078 | 207.1212 | 205.7480 | 311.8584 | 398.5156 | 363.3633 | 448.1382 (95) |
| Ext temp. | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 (96) |
| Heat loss rate W | | | | | | | | | | | | |
| | 851.4579 | 833.5329 | 759.7515 | 638.4325 | 481.4573 | 314.7654 | 213.1272 | 212.3153 | 346.8185 | 529.3431 | 672.0768 | 837.4609 (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 | | | | | | | | | | | | |
| | 284.7606 | 224.4846 | 185.3024 | 105.6254 | 50.7876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 97.3357 | 222.2737 | 289.6561 (98) |
| Space heating | | | | | | | | | | | | 1460.2262 (98) |
| Space heating per m2 | | | | | | | | | | | | (98) / (4) = 25.5821 (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) | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | 1613.5096 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating requirement | 284.7606 | 224.4846 | 185.3024 | 105.6254 | 50.7876 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 97.3357 | 222.2737 | 289.6561 (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 (210) |
| Space heating fuel (main heating system) | 314.6526 | 248.0493 | 204.7540 | 116.7132 | 56.1189 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 107.5533 | 245.6063 | 320.0620 (211) |
| Water heating requirement | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | 117.2131 | 86.9540 | 64.2209 | 24.0000 | 5.0389 | 0.0000 | 0.0000 | 7.6232 | 28.4345 | 68.6287 | 125.8214 | 118.1143 (64) |
| Efficiency of water heater | | | | | | | | | | | | 87.3000 (216) |
| (217)m | 89.5429 | 89.5832 | 89.6542 | 89.8899 | 90.2016 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.1487 | 89.3166 | 89.5492 (217) |
| Fuel for water heating, kWh/month | 130.9015 | 97.0651 | 71.6318 | 26.6993 | 5.5862 | 0.0000 | 0.0000 | 8.7321 | 32.5710 | 76.9822 | 140.8713 | 131.8987 (219) |
| Water heating fuel used | | | | | | | | | | | | 722.9392 (219) |
| Annual totals kWh/year | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | 1613.5096 (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) |
| pump for solar water heating | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 125.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 270.1038 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = | | | | | | | | | | -1823.5358 | | -1823.5358 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | 908.0169 (238) |

10a. Fuel costs - using BEDF prices (485)

| | | | |
|---------------------------------------|---------------|------------------|------------------|
| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
| Space heating - main system 1 | 1613.5096 | 3.7400 | 60.3453 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 722.9392 | 3.7400 | 27.0379 (247) |
| Pumps and fans for heating | 75.0000 | 19.1200 | 14.3400 (249) |
| Pump for solar water heating | 50.0000 | 19.1200 | 9.5600 (249) |
| Energy for lighting | 270.1038 | 19.1200 | 51.6438 (250) |
| Additional standing charges | | | 94.0000 (251) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 19.1200 | -348.6600 (252) |
| Total energy cost | | | -91.7330 (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 | 1613.5096 | 0.2160 | 348.5181 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 722.9392 | 0.2160 | 156.1549 (264) |
| Space and water heating | | | 504.6730 (265) |
| Pumps and fans | 125.0000 | 0.5190 | 64.8750 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 0.5190 | -946.4151 (269) |
| Total kg/year | | | -236.6832 (272) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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 | 1613.5096 | 1.2200 | 1968.4818 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 722.9392 | 1.2200 | 881.9858 (264) |
| Space and water heating | | | 2850.4676 (265) |
| Pumps and fans | 125.0000 | 3.0700 | 383.7500 (267) |
| Energy for lighting | 270.1038 | 3.0700 | 829.2187 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 3.0700 | -5598.2549 (269) |
| Primary energy kWh/year | | | -1534.8186 (272) |
| Primary energy kWh/m2/year | | | -26.8889 (273) |

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

Overheating Calculation Input Data

| | |
|---|--------------------------|
| Dwelling type | MidTerrace House |
| Number of storeys | 2 |
| Cross ventilation possible | Yes |
| SAP Region | Severn Valley |
| Front of dwelling faces | North West |
| Overshading | Average or unknown |
| Thermal mass parameter | 100.0 |
| Night ventilation | No |
| Ventilation rate during hot weather (ach) | 4.00 (Windows half open) |

Overheating Calculation

| | |
|--|-------------|
| Summer ventilation heat loss coefficient | 183.47 (P1) |
| Transmission heat loss coefficient | 34.63 (37) |
| Summer heat loss coefficient | 218.10 (P2) |

Overhangs

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

Solar shading

| Orientation | Z blinds | Solar access | Z overhangs | Z summer |
|-------------|----------|--------------|-------------|------------|
| South East | 0.850 | 0.90 | 1.000 | 0.765 (P8) |
| North West | 0.850 | 0.90 | 1.000 | 0.765 (P8) |

| [Jul] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Shading | Gains W |
|------------|---------|--------------------------|-----------------------------|------------------------------|---------|----------|
| South East | 2.9400 | 121.5729 | 0.7100 | 0.7000 | 0.7650 | 122.3050 |
| South East | 3.2000 | 121.5729 | 0.7100 | 0.7000 | 0.7650 | 133.1211 |
| North West | 3.3100 | 100.3588 | 0.7100 | 0.7000 | 0.7650 | 113.6695 |

total: 369.0956

| | | | | |
|--|-----------------|--------|--------|------|
| Solar gains | 401 | 369 | 330 | (P3) |
| Internal gains | 339 | 325 | 332 | |
| Total summer gains | 740 | 694 | 662 | (P5) |
| Summer gain/loss ratio | 3.39 | 3.18 | 3.03 | (P6) |
| Summer external temperature | 15.00 | 16.70 | 16.70 | |
| Thermal mass temperature increment (TMP = 100.0) | 1.30 | 1.30 | 1.30 | |
| Threshold temperature | 19.69 | 21.18 | 21.03 | (P7) |
| Likelihood of high internal temperature | Not significant | Slight | Slight | |

Assessment of likelihood of high internal temperature: Slight

ASSESSMENT NOTES

Calculation Type: New Build (As Designed)



| | | | |
|----------------------|---------------|----------------|----------------------|
| Property Reference | Plot 004 | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 4 | Prop Type Ref | Washington Eaves END |
| Property | 2 bed, 1 bath | | |

| | | | | | |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating | 83 B | DER | 18.75 | TER | 19.83 |
| Environmental | 87 B | % DER<TER | 5.47 | | |
| CO ₂ Emissions (t/year) | 0.96 | DFEE | 45.82 | TFEE | 51.41 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 10.87 | | |

| | | | |
|------------------|--|-------------|-----------|
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | Assessor ID | R034-0001 |
|------------------|--|-------------|-----------|

| | |
|--------|--|
| Client | |
|--------|--|

ASSESSMENT NOTES - Last time updated on: 17.11.2021

Celotex and ISOVER are separate legal entities to Darren Evans Assessments. Darren Evans Assessments provides the warranty and assumes responsibility for the Energy Assessments Service offered under a commercial agreement with Celotex and ISOVER

PREDICTED ENERGY ASSESSMENT



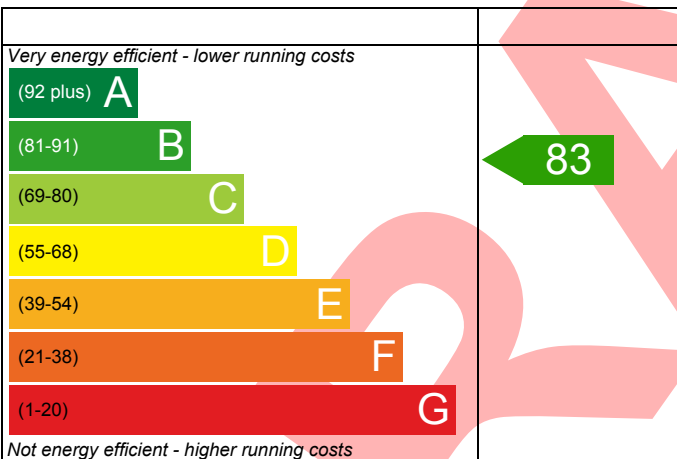
2 bed,
1 bath

Dwelling type: House, End-Terrace
 Date of assessment: 17/11/2021
 Produced by: Michael Brogden
 Total floor area: 57.08 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO₂) emissions.

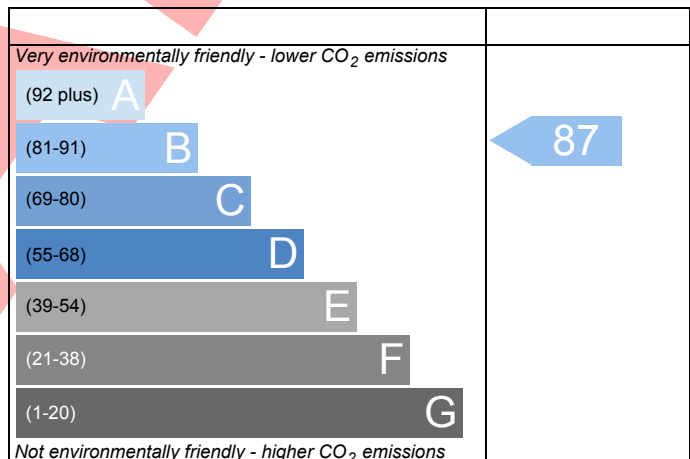
Energy Efficiency Rating



England EU Directive 2002/91/EC

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO₂) Rating



England EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



| | | | |
|----------------------|---------------|----------------|----------------------|
| Property Reference | Plot 004 | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 4 | Prop Type Ref | Washington Eaves END |
| Property | 2 bed, 1 bath | | |

| | | | | | |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating | 83 B | DER | 18.75 | TER | 19.83 |
| Environmental | 87 B | % DER<TER | 5.47 | | |
| CO ₂ Emissions (t/year) | 0.96 | DFEE | 45.82 | TFEE | 51.41 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 10.87 | | |

| | | | |
|------------------|--|-------------|-----------|
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | Assessor ID | R034-0001 |
|------------------|--|-------------|-----------|

| | |
|--------|--|
| Client | |
|--------|--|

SUMMARY FOR INPUT DATA FOR: New Build (As Designed)

| | |
|-----------------------|--------------------|
| Orientation | North West |
| Property Tenure | Unknown |
| Transaction Type | New dwelling |
| Terrain Type | Urban |
| 1.0 Property Type | House, End-Terrace |
| 2.0 Number of Storeys | 2 |
| 3.0 Date Built | 2021 |
| 4.0 Sheltered Sides | 2 |
| 5.0 Sunlight/Shade | Average or unknown |

6.0 Measurements

| | Heat Loss Perimeter | Internal Floor Area | Average Storey Height |
|---------------|---------------------|----------------------|-----------------------|
| Ground Floor: | 15.13 m | 28.54 m ² | 2.31 m |
| 1st Storey: | 15.13 m | 28.54 m ² | 2.56 m |

| | | |
|-----------------|-------|----------------|
| 7.0 Living Area | 17.91 | m ² |
|-----------------|-------|----------------|

| | | |
|----------------------------|--------------------------|---------------------|
| 8.0 Thermal Mass Parameter | Simple calculation - Low | |
| Thermal Mass | 100.00 | kJ/m ² K |

9.0 External Walls

| Description | Type | U-Value (W/m ² K) | Gross Area (m ²) | Nett Area (m ²) |
|-----------------|-------------|------------------------------|------------------------------|-----------------------------|
| External Wall 1 | Cavity Wall | 0.27 | 73.70 | 62.32 |

9.1 Party Walls

| Description | Type | Construction | U-Value (W/m ² K) | Area (m ²) |
|--------------|---------------------------------|--------------|------------------------------|------------------------|
| Party Wall 1 | Filled Cavity with Edge Sealing | | 0.00 | 34.80 |

10.0 External Roofs

| Description | Type | U-Value (W/m ² K) | Gross Area (m ²) | Nett Area (m ²) |
|-----------------|---------------------|------------------------------|------------------------------|-----------------------------|
| External Roof 1 | External Plane Roof | 0.10 | 28.54 | 28.54 |

10.2 Internal Ceilings

| Description | Construction | Area (m ²) |
|-------------|--------------|------------------------|
|-------------|--------------|------------------------|

11.0 Heat Loss Floors

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



| Description | Type | Construction | U-Value (W/m ² K) | Area (m ²) |
|-------------------|----------------------|--------------|------------------------------|------------------------|
| Heat Loss Floor 1 | Ground Floor - Solid | | 0.15 | 28.54 |

11.2 Internal Floors

| Description | Construction | Area (m ²) |
|-------------|--------------|------------------------|
|-------------|--------------|------------------------|

12.0 Opening Types

| Description | Data Source | Type | Glazing | Glazing Gap | Argon Filled | G-value | Frame Type | Frame Factor | U Value (W/m ² K) |
|------------------------|--------------|------------|---------------|-------------|--------------|---------|------------|--------------|------------------------------|
| French Door | Manufacturer | Window | Double glazed | | | 0.71 | | 0.70 | 1.41 |
| Window | Manufacturer | Window | Double glazed | | | 0.71 | | 0.70 | 1.41 |
| Solid door tall window | Manufacturer | Solid Door | | | | | | | 1.20 |

13.0 Openings

| Name | Opening Type | Location | Orientation | Curtain Type | Overhang Ratio | Wide Overhang | Width (m) | Height (m) | Count | Area (m ²) | Curtain Closed |
|------------------|--------------|---------------------|-------------|---------------------------------------|----------------|---------------|-----------|------------|-------|------------------------|----------------|
| Front door | Solid Door | [1] External Wall 1 | North West | | | | | | | 1.93 | |
| front windows | Window | [1] External Wall 1 | North West | Dark-coloured curtain or roller blind | 0.00 | | | | | 3.31 | 100 |
| rear french door | Window | [1] External Wall 1 | South East | Dark-coloured curtain or roller blind | 0.00 | | | | | 2.94 | 100 |
| rear windows | Window | [1] External Wall 1 | South East | Dark-coloured curtain or roller blind | 0.00 | | | | | 3.20 | 100 |

14.0 Conservatory

15.0 Draught Proofing

 %

16.0 Draught Lobby

17.0 Thermal Bridging

17.1 List of Bridges

| Source Type | Bridge Type | Length | Psi | Imported | Reference: |
|------------------------|--|--------|-------|----------|------------------------------|
| Independently assessed | E2 Other lintels (including other steel lintels) | 7.00 | 0.211 | No | H+H LN01 - EW01 |
| Independently assessed | E3 Sill | 3.68 | 0.019 | No | APA PF-WD-03 |
| Independently assessed | E4 Jamb | 15.60 | 0.020 | No | APA PF-WD-04 |
| Independently assessed | E5 Ground floor (normal) | 15.13 | 0.044 | No | GF02 - EW01 |
| Independently assessed | E6 Intermediate floor within a dwelling | 15.13 | 0.001 | No | APA PF-IF-01 |
| Table K1 - Approved | E10 Eaves (insulation at ceiling level) | 7.99 | 0.060 | No | |
| Independently assessed | E12 Gable (insulation at ceiling level) | 7.15 | 0.047 | No | APA PF-RG-01 |
| Independently assessed | E16 Corner (normal) | 9.74 | 0.047 | No | H+H CN01-EW01 |
| Table K1 - Approved | E18 Party wall between dwellings | 9.74 | 0.060 | No | |
| Independently assessed | P1 Party wall - Ground floor | 7.15 | 0.053 | No | PW01 - EW01 |
| Table K1 - Default | P2 Party wall - Intermediate floor within a dwelling | 7.15 | 0.000 | No | |
| Independently assessed | P4 Party wall - Roof (insulation at ceiling level) | 7.15 | 0.036 | No | Barratt Confidential Bespoke |

| | | |
|---------|------------------------------------|--------------------|
| Y-value | <input type="text" value="0.038"/> | W/m ² K |
|---------|------------------------------------|--------------------|

18.0 Pressure Testing

| | | |
|---------------------------|-----------------------------------|---|
| Designed AP ₅₀ | <input type="text" value="5.00"/> | m ³ /(h.m ²) @ 50 Pa |
|---------------------------|-----------------------------------|---|

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



Property Tested ?
 As Built AP₅₀ m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather
 Cross ventilation possible
 Night Ventilation
 Air change rate

Mechanical Ventilation

Mechanical Ventilation System Present

20.0 Fans, Open Fireplaces, Flues

| | MHS | SHS | Other | Total |
|------------------------------|-----|-----|-------|-------|
| Number of Chimneys | 0 | | 0 | 0 |
| Number of open flues | 0 | | 0 | 0 |
| Number of intermittent fans | | | | 4 |
| Number of passive vents | | | | 0 |
| Number of flueless gas fires | | | | 0 |

21.0 Fixed Cooling System

22.0 Lighting

Internal

Total number of light fittings
 Total number of L.E.L. fittings
 Percentage of L.E.L. fittings %

External

External lights fitted

23.0 Electricity Tariff

24.0 Main Heating 1

Percentage of Heat %
 Database Ref. No.
 Fuel Type
 Main Heating
 SAP Code
 In Winter
 In Summer
 Controls
 PCDF Controls
 Delayed Start Stat
 Sap Code
 Flue Type
 Fan Assisted Flue
 Is MHS Pumped
 Heat Emitter
 Flow Temperature
 Combi boiler type
 Combi keep hot type

25.0 Main Heating 2

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Designed)



| | |
|--|-------------------------|
| Community Heating | None |
| 28.0 Water Heating | HWP From main heating 1 |
| Water Heating | Main Heating 1 |
| Flue Gas Heat Recovery System | No |
| Waste Water Heat Recovery Instantaneous System 1 | No |
| Waste Water Heat Recovery Instantaneous System 2 | No |
| Waste Water Heat Recovery Storage System | No |
| Solar Panel | No |
| Water use <= 125 litres/person/day | Yes |
| SAP Code | 901 |
| 29.0 Hot Water Cylinder | None |

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

| | Typical Cost | Typical savings per year | Ratings after improvement | |
|------------------------------------|-----------------|--------------------------|---------------------------|----------------------|
| | | | SAP rating | Environmental Impact |
| Solar water heating | £4,000 - £6,000 | £23 | B 84 | |
| | Typical Cost | Typical savings per year | Ratings after improvement | |
| | | | SAP rating | Environmental Impact |
| Solar photovoltaic panels, 2.5 kWp | £3,500 - £5,500 | £349 | A 97 | |

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Designed)



| | | | |
|-----------------------------|---------------|-----------------------|----------------------|
| Property Reference | Plot 004 | Issued on Date | 17/11/2021 |
| Assessment Reference | Plot 4 | Prop Type Ref | Washington Eaves END |
| Property | 2 bed, 1 bath | | |

| | | | | | |
|--|------|-----------------------|-------|-------------|-------|
| SAP Rating | 83 B | DER | 18.75 | TER | 19.83 |
| Environmental | 87 B | % DER<TER | 5.47 | | |
| CO₂ Emissions (t/year) | 0.96 | DFEE | 45.82 | TFEE | 51.41 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 10.87 | | |

| | | | |
|-------------------------|--|--------------------|-----------|
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | Assessor ID | R034-0001 |
|-------------------------|--|--------------------|-----------|

| | |
|---------------|--|
| Client | |
|---------------|--|

SUMMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

| | | | |
|---|------------------|-----------------------------------|------|
| Fuel for main heating | Mains gas | | |
| Fuel factor | 1.00 (mains gas) | | |
| Target Carbon Dioxide Emission Rate (TER) | 19.83 | kgCO ₂ /m ² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 18.75 | kgCO ₂ /m ² | Pass |
| | -1.08 (-5.4%) | kgCO ₂ /m ² | |

1b TFEE and DFEE

| | | | |
|--|---------------|------------------------|------|
| Target Fabric Energy Efficiency (TFEE) | 51.41 | kWh/m ² /yr | |
| Dwelling Fabric Energy Efficiency (DFEE) | 45.82 | kWh/m ² /yr | |
| | -5.6 (-10.9%) | kWh/m ² /yr | Pass |

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

| Element | Average | Highest | |
|---------------|------------------|------------------|------|
| External wall | 0.27 (max. 0.30) | 0.27 (max. 0.70) | Pass |
| Party wall | 0.00 (max. 0.20) | - | Pass |
| Floor | 0.15 (max. 0.25) | 0.15 (max. 0.70) | Pass |
| Roof | 0.10 (max. 0.20) | 0.10 (max. 0.35) | Pass |
| Openings | 1.37 (max. 2.00) | 1.41 (max. 3.30) | Pass |

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 | Pass |

Limiting System Efficiencies

4 Heating efficiency

BASIC COMPLIANCE REPORT

Calculation Type: New Build (As Designed)



Main heating system

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

Pass

Secondary heating system

None

5 Cylinder insulation

Hot water storage

No cylinder

6 Controls

Space heating controls

Time and temperature zone control

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100 %

Minimum

75 %

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Severn Valley)

Slight

Pass

Based on:

Overshading

Average

Windows facing South East

6.14 m², No overhang

Windows facing North West

3.31 m², No overhang

Air change rate

4.00 ach

Blinds/curtains

Dark-coloured curtain or roller blind, closed 100% of daylight hours

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type

U-value

Filled Cavity with Edge Sealing

0.00

W/m²K

Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

5.00 (design value)

Maximum

10.0

Pass

10 Key features

Party wall U-value

0.00

W/m²K

Roof U-value

0.10

W/m²K

Thermal bridging γ -value

0.038

W/m²K

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



| | | | | | |
|------------------------------------|---|---------------|----------------------|-------------|-----------|
| Property Reference | Plot 004 | | Issued on Date | 17/11/2021 | |
| Assessment Reference | Plot 4 | Prop Type Ref | Washington Eaves END | | |
| Property | 2 bed, 1 bath | | | | |
| SAP Rating | 83 B | DER | 18.75 | TER | 19.83 |
| Environmental | 87 B | % DER<TER | 5.47 | | |
| CO ₂ Emissions (t/year) | 0.96 | DFEE | 45.82 | TFEE | 51.41 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 10.87 | | |
| Assessor Details | Mr. Michael Brogden, Michael Brogden, Tel: 0333 5777 577, michael@darren-evans.co.uk | | | Assessor ID | R034-0001 |
| Client | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 57 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) 19.83 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.75 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.8 kWh/m²/yrOK

2 Fabric U-values

| Element | Average | Highest | |
|---------------|------------------|------------------|----|
| External wall | 0.27 (max. 0.30) | 0.27 (max. 0.70) | OK |
| Party wall | 0.00 (max. 0.20) | - | OK |
| Floor | 0.15 (max. 0.25) | 0.15 (max. 0.70) | OK |
| Roof | 0.10 (max. 0.20) | 0.10 (max. 0.35) | OK |
| Openings | 1.37 (max. 2.00) | 1.41 (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 database

Ideal LOGIC COMBI ESP1 35

Combi boiler

Efficiency: 89.6% SEDBUK2009

Minimum: 88.0%

OK

Secondary heating system:

None

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

Not applicable

9 Summertime temperature

Overheating risk (Severn Valley): Slight OK

Based on:

Overshading:

Average

Windows facing South East:

6.14 m², No overhang

Windows facing North West:

3.31 m², No overhang

Air change rate:

4.00 ach

Blinds/curtains:

Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.10 W/m²K

Thermal bridging y-value 0.038 W/m²K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) | | | | | | | |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) | | | | | | | |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) | | | | | | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = | | | | 40.0000 / (5) = | 0.2878 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 | | | | | |
|---|-------------|-------------|-------------|---------------|----------------------|----------------|---------------|-------------|-------------|-------------|-------------|------------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) | | | | | |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) | | | | | |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) | | | | | |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 100.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 5.0338 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 43.9243 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 30.7236 | Feb 30.4211 | Mar 30.1246 | Apr 28.7318 | May 28.4713 | Jun 27.2582 | Jul 27.2582 | Aug 27.0336 | Sep 27.7255 | Oct 28.4713 | Nov 28.9984 | Dec 29.5495 (38) |
| Heat transfer coeff | 74.6478 | 74.3453 | 74.0488 | 72.6561 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.6498 | 72.3955 | 72.9227 | 73.4738 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.6549 (39) |
| HLP | Jan 1.3078 | Feb 1.3025 | Mar 1.2973 | Apr 1.2729 | May 1.2683 | Jun 1.2471 | Jul 1.2471 | Aug 1.2431 | Sep 1.2553 | Oct 1.2683 | Nov 1.2776 | Dec 1.2872 (40) |
| HLP (average) | | | | | | | | | | | | 1.2729 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Water storage loss: | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | (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 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 15.2944 | 13.5843 | 11.0475 | 8.3637 | 6.2520 | 5.2782 | 5.7032 | 7.4133 | 9.9501 | 12.6339 | 14.7457 | 15.7195 | 15.7195 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.5274 | 167.2450 | 162.9166 | 153.7018 | 142.0699 | 131.1375 | 123.8340 | 122.1163 | 126.4448 | 135.6595 | 147.2915 | 158.2238 | 158.2238 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | (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 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | 60.6823 | (72) |
| Total internal gains | 297.8004 | 295.9706 | 285.2937 | 268.2150 | 251.1076 | 234.4667 | 223.5660 | 228.7143 | 237.4131 | 254.6729 | 274.4707 | 289.0954 | 289.0954 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | | |
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 37.2574 | (77) | | | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 40.5522 | (77) | | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7700 | 12.8629 | (81) | | | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | 77.0933 | (83) |
| Total gains | 388.4729 | 454.6920 | 513.8119 | 570.3821 | 606.9224 | 595.3456 | 568.3135 | 532.2706 | 491.2526 | 433.1537 | 383.8535 | 366.1887 | 366.1887 | (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 | 21.2405 | 21.3269 | 21.4123 | 21.8227 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.1293 | 21.9013 | 21.7430 | 21.5799 | 21.5799 | |
| alpha | 2.4160 | 2.4218 | 2.4275 | 2.4548 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4753 | 2.4601 | 2.4495 | 2.4387 | 2.4387 | |
| util living area | 0.9581 | 0.9383 | 0.9053 | 0.8435 | 0.7469 | 0.6129 | 0.4868 | 0.5275 | 0.7145 | 0.8721 | 0.9403 | 0.9631 | 0.9631 | (86) |
| MIT | 18.4049 | 18.7099 | 19.1877 | 19.8050 | 20.3386 | 20.7253 | 20.8893 | 20.8616 | 20.5670 | 19.8720 | 19.0436 | 18.3656 | 18.3656 | (87) |
| Th 2 | 19.8347 | 19.8389 | 19.8430 | 19.8621 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8761 | 19.8657 | 19.8585 | 19.8509 | 19.8509 | (88) |
| util rest of house | 0.9515 | 0.9287 | 0.8902 | 0.8173 | 0.7016 | 0.5386 | 0.3833 | 0.4250 | 0.6490 | 0.8451 | 0.9295 | 0.9573 | 0.9573 | (89) |
| MIT 2 | 16.4009 | 16.8416 | 17.5284 | 18.4098 | 19.1375 | 19.6369 | 19.8123 | 19.7920 | 19.4558 | 18.5237 | 17.3403 | 16.3527 | 16.3527 | (90) |
| Living area fraction | fLA = Living area / (4) = | | | | | | | | | | | | 0.3138 | (91) |
| MIT | 17.0297 | 17.4278 | 18.0491 | 18.8476 | 19.5144 | 19.9784 | 20.1502 | 20.1276 | 19.8044 | 18.9468 | 17.8747 | 16.9843 | 16.9843 | (92) |
| Temperature adjustment | | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 16.8797 | 17.2778 | 17.8991 | 18.6976 | 19.3644 | 19.8284 | 20.0002 | 19.9776 | 19.6544 | 18.7968 | 17.7247 | 16.8343 | 16.8343 | (93) |

8. Space heating requirement

| | | | | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|---------|------|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
| | 0.9269 | 0.8992 | 0.8566 | 0.7843 | 0.6785 | 0.5346 | 0.3950 | 0.4342 | 0.6341 | 0.8124 | 0.9009 | 0.9347 | 0.9347 | (94) | |
| Useful gains | 360.0807 | 408.8737 | 440.1163 | 447.3650 | 411.7789 | 318.2734 | 224.4804 | 231.1216 | 311.5103 | 351.8853 | 345.8109 | 342.2682 | 342.2682 | (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 | 4.2000 | (96) | |
| Heat loss rate W | 939.0464 | 920.2346 | 844.0877 | 711.8521 | 554.8671 | 372.1704 | 242.0375 | 253.8569 | 397.9749 | 593.4120 | 774.7845 | 928.2879 | 928.2879 | (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 | 1.0000 | (97a) | |
| Space heating kWh | 430.7504 | 343.6345 | 300.5547 | 190.4307 | 106.4576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.6959 | 308.8610 | 435.9987 | 435.9987 | (98) | |
| Space heating | | | | | | | | | | | | | 2296.3835 | (98) | |
| Space heating per m2 | | | | | | | | | | | | | (98) / (4) = | 40.2310 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 | (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 | (208) |
| Space heating requirement | | | | | | | | | | | | | 2537.4403 | (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Space heating requirement | 430.7504 | 343.6345 | 300.5547 | 190.4307 | 106.4576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.6959 | 308.8610 | 435.9987 | (98) | |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) | |
| Space heating fuel (main heating system) | 475.9673 | 379.7067 | 332.1046 | 210.4207 | 117.6328 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.5590 | 341.2828 | 481.7665 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) | |
| Efficiency of water heater (217)m | 89.6792 | 89.6199 | 89.5057 | 89.2663 | 88.8337 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.1934 | 89.5338 | 87.3000 | (216) | |
| Fuel for water heating, kWh/month | 159.8472 | 140.3256 | 146.0227 | 129.1170 | 125.5919 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.1095 | 143.9416 | 155.2446 | (219) | |
| Water heating fuel used | | | | | | | | | | | | | 1589.3220 | (219) |
| Annual totals kWh/year | | | | | | | | | | | | | 2537.4403 | (211) |
| Space heating fuel - main system | | | | | | | | | | | | | 0.0000 | (215) |
| Space heating fuel - secondary | | | | | | | | | | | | | 30.0000 | (230c) |
| Electricity for pumps and fans: | | | | | | | | | | | | | 45.0000 | (230e) |
| central heating pump | | | | | | | | | | | | | 75.0000 | (231) |
| main heating flue fan | | | | | | | | | | | | | 270.1038 | (232) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | | 4471.8661 | (238) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | | 75.0000 | (231) |
| Total delivered energy for all uses | | | | | | | | | | | | | 270.1038 | (232) |
| | | | | | | | | | | | | | 4471.8661 | (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 | 2537.4403 | 0.2160 | 548.0871 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1589.3220 | 0.2160 | 343.2936 (264) |
| Space and water heating | | | 891.3807 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total CO2, kg/year | | | 1070.4895 (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 18.7500 (273) |

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

| | TFA | N | EF |
|---|---------|--------|-------------|
| DER | | | 18.7500 ZC1 |
| Total Floor Area | 57.0800 | | |
| Assumed number of occupants | 1.8980 | | |
| CO2 emission factor in Table 12 for electricity displaced from grid | | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | | 17.1843 ZC2 |
| CO2 emissions from cooking, equation (L16) | | | 2.8828 ZC3 |
| Total CO2 emissions | | | 38.8171 ZC4 |
| Residual CO2 emissions offset from biofuel CHP | | | 0.0000 ZC5 |
| Additional allowable electricity generation, kWh/m²/year | | | 0.0000 ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | | | 0.0000 ZC7 |
| Net CO2 emissions | | | 38.8171 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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) = | | | | 20.0000 / (5) = | 0.1439 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | 0.3939 (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) = | | 0.3348 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| Effective ac | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (25) |

3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | | | | | |
|---|-------------|-------------|-------------|---------------|------------------------------|----------------|----------------------------|-------------|-------------|-------------|-------------|------------------|
| TER Opaque door | | | 1.9300 | 1.0000 | 1.9300 | | (26) | | | | | |
| TER Opening Type (Uw = 1.40) | | | 9.4500 | 1.3258 | 12.5284 | | (27) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1300 | 3.7102 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.1800 | 11.2176 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1300 | 3.7102 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = 33.0964 | | (33) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 250.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 7.5342 (36) | | | | | |
| Total fabric heat loss | | | | | | | (33) + (36) = 40.6306 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 27.1125 | Feb 26.9502 | Mar 26.7911 | Apr 26.0440 | May 25.9042 | Jun 25.2535 | Jul 25.2535 | Aug 25.1329 | Sep 25.5041 | Oct 25.9042 | Nov 26.1870 | Dec 26.4826 (38) |
| Heat transfer coeff | 67.7431 | 67.5808 | 67.4217 | 66.6746 | 66.5348 | 65.8841 | 65.8841 | 65.7636 | 66.1347 | 66.5348 | 66.8176 | 67.1132 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 66.6739 (39) |
| HLP | Jan 1.1868 | Feb 1.1840 | Mar 1.1812 | Apr 1.1681 | May 1.1656 | Jun 1.1542 | Jul 1.1542 | Aug 1.1521 | Sep 1.1586 | Oct 1.1656 | Nov 1.1706 | Dec 1.1758 (40) |
| HLP (average) | | | | | | | | | | | | 1.1681 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss: | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | |

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Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) | |
| | 44.4387 | 38.6786 | 41.2068 | 38.3137 | 37.9749 | 35.1861 | 36.3589 | 37.9749 | 38.3137 | 41.2068 | 41.4414 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | 44.4387 | (61) |
| Total heat required for water heating calculated for each month | 173.7612 | 151.7849 | 157.9223 | 140.0692 | 135.6117 | 119.4392 | 114.4318 | 127.5647 | 128.9735 | 146.8620 | 156.7723 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | (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 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63) |
| Output from w/h | 173.7612 | 151.7849 | 157.9223 | 140.0692 | 135.6117 | 119.4392 | 114.4318 | 127.5647 | 128.9735 | 146.8620 | 156.7723 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | 169.6806 | (64) |
| Heat gains from water heating, kWh/month | 54.1094 | 47.2775 | 49.1096 | 43.4121 | 41.9579 | 36.8107 | 35.0490 | 39.2823 | 39.7228 | 45.4321 | 48.7079 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | 52.7526 | (65) |
| | | | | | | | | | | | | | | | | | | | | | | | | (66) |
| | | | | | | | | | | | | | | | | | | | | | | | | (67) |
| | | | | | | | | | | | | | | | | | | | | | | | | (68) |
| | | | | | | | | | | | | | | | | | | | | | | | | (69) |
| | | | | | | | | | | | | | | | | | | | | | | | | (70) |
| | | | | | | | | | | | | | | | | | | | | | | | | (71) |
| | | | | | | | | | | | | | | | | | | | | | | | | (72) |
| | | | | | | | | | | | | | | | | | | | | | | | | (73) |

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) |
| (66)m | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | 94.8995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 15.2944 | 13.5843 | 11.0475 | 8.3637 | 6.2520 | 5.2782 | 5.7032 | 7.4133 | 9.9501 | 12.6339 | 14.7457 | 15.7195 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.5274 | 167.2450 | 162.9166 | 153.7018 | 142.0699 | 131.1375 | 123.8340 | 122.1163 | 126.4448 | 135.6595 | 147.2915 | 158.2238 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | 32.4899 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 72.7277 | 70.3534 | 66.0075 | 60.2946 | 56.3951 | 51.1259 | 47.1088 | 52.7988 | 55.1706 | 61.0646 | 67.6498 | 70.9041 | (72) |
| Total internal gains | 308.0193 | 305.6526 | 294.4415 | 276.8300 | 259.1868 | 242.0115 | 231.1159 | 236.7983 | 246.0353 | 263.8279 | 284.1568 | 299.3172 | (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 | | | | | | | |
| Southeast | 6.1400 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 69.0423 (77) | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 11.4136 (81) | | | | | | |
| Solar gains | 80.4559 | 140.8373 | 202.7696 | 268.1201 | 315.7230 | 320.2165 | 305.9027 | 269.3528 | 225.2379 | 158.3703 | 97.0580 | 68.4067 (83) |
| Total gains | 388.4752 | 446.4899 | 497.2111 | 544.9501 | 574.9098 | 562.2280 | 537.0187 | 506.1511 | 471.2732 | 422.1982 | 381.2148 | 367.7239 (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, nil,m (see Table 9a) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 58.5136 | 58.6541 | 58.7925 | 59.4513 | 59.5762 | 60.1646 | 60.1646 | 60.2749 | 59.9366 | 59.5762 | 59.3240 | 59.0627 | |
| alpha | 4.9009 | 4.9103 | 4.9195 | 4.9634 | 4.9717 | 5.0110 | 5.0110 | 5.0183 | 4.9958 | 4.9717 | 4.9549 | 4.9375 | |
| util living area | 0.9965 | 0.9925 | 0.9820 | 0.9488 | 0.8616 | 0.6961 | 0.5282 | 0.5786 | 0.8195 | 0.9647 | 0.9928 | 0.9973 (86) | |
| MIT | 19.7837 | 19.9455 | 20.1994 | 20.5249 | 20.7975 | 20.9502 | 20.9898 | 20.9842 | 20.8848 | 20.5330 | 20.0980 | 19.7541 (87) | |
| Th 2 | 19.9306 | 19.9328 | 19.9351 | 19.9456 | 19.9476 | 19.9568 | 19.9568 | 19.9585 | 19.9532 | 19.9476 | 19.9436 | 19.9394 (88) | |
| util rest of house | 0.9953 | 0.9900 | 0.9757 | 0.9301 | 0.8126 | 0.6036 | 0.4090 | 0.4571 | 0.7421 | 0.9481 | 0.9899 | 0.9964 (89) | |
| MIT 2 | 18.3215 | 18.5584 | 18.9270 | 19.3941 | 19.7515 | 19.9241 | 19.9531 | 19.9521 | 19.8634 | 19.4149 | 18.7893 | 18.2846 (90) | |
| Living area fraction | fLA = Living area / (4) = | | | | | | | | | | | | 0.3138 (91) |
| MIT | 18.7803 | 18.9936 | 19.3263 | 19.7489 | 20.0797 | 20.2461 | 20.2784 | 20.2759 | 20.1839 | 19.7657 | 19.1999 | 18.7457 (92) | |
| Temperature adjustment | | | | | | | | | | | | | 0.0000 |
| adjusted MIT | 18.7803 | 18.9936 | 19.3263 | 19.7489 | 20.0797 | 20.2461 | 20.2784 | 20.2759 | 20.1839 | 19.7657 | 19.1999 | 18.7457 (93) | |

8. Space heating requirement

| | | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|--------------|
| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Useful gains | 0.9935 | 0.9870 | 0.9710 | 0.9258 | 0.8195 | 0.6308 | 0.4466 | 0.4955 | 0.7612 | 0.9444 | 0.9871 | 0.9950 | (94) |
| Ext temp. | 385.9593 | 440.6768 | 482.7819 | 504.5247 | 471.1512 | 354.6517 | 239.8576 | 250.7821 | 358.7470 | 398.7090 | 376.3016 | 365.8707 (95) | |
| Heat loss rate W | 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) | |
| Month fracti | 980.9381 | 952.4557 | 864.7689 | 723.3448 | 557.5427 | 371.9853 | 242.3457 | 254.8955 | 402.3545 | 609.8394 | 808.4869 | 976.2096 (97) | |
| Space heating kWh | 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 | 442.6643 | 343.9154 | 284.1983 | 157.5505 | 64.2753 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.0810 | 311.1734 | 454.0922 (98) | |
| Space heating per m2 | | | | | | | | | | | | 2214.9505 (98) | |
| | | | | | | | | | | | | (98) / (4) = | 38.8043 (99) |

8c. Space cooling requirement

Not applicable

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | 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 | | | | | | | | | | | | | 2371.4673 (211) |
| Space heating requirement | 442.6643 | 343.9154 | 284.1983 | 157.5505 | 64.2753 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 157.0810 | 311.1734 | 454.0922 | (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) | 473.9446 | 368.2178 | 304.2809 | 168.6836 | 68.8173 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 168.1810 | 333.1621 | 486.1801 | (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 | 173.7612 | 151.7849 | 157.9223 | 140.0692 | 135.6117 | 119.4392 | 114.4318 | 127.5647 | 128.9735 | 146.8620 | 156.7723 | 169.6806 | (64) |
| Efficiency of water heater (217)m | 87.3046 | 87.0475 | 86.5132 | 85.3478 | 83.2924 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.2207 | 86.7447 | 87.4093 | (216) |
| Fuel for water heating, kWh/month | 199.0286 | 174.3702 | 182.5413 | 164.1157 | 162.8140 | 148.7412 | 142.5054 | 158.8601 | 160.6145 | 172.3313 | 180.7284 | 194.1219 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 2040.7726 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 2371.4673 (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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4757.3437 (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 | 2371.4673 | 0.2160 | 512.2369 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 2040.7726 | 0.2160 | 440.8069 (264) |
| Space and water heating | | | 953.0438 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total CO2, kg/m2/year | | | 1132.1527 (272) |
| Emissions per m2 for space and water heating | | | 16.6966 (272a) |
| Fuel factor (mains gas) | | | 1.0000 |
| Emissions per m2 for lighting | | | 2.4559 (272b) |
| Emissions per m2 for pumps and fans | | | 0.6819 (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (16.6966 * 1.00) + 2.4559 + 0.6819, rounded to 2 d.p. | | | 19.8300 (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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (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 | | | | | 2 * 10 = 20.0000 (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) | | | | | 20.0000 / (5) = 0.1439 (8) |
| Pressure test | | | | | Yes |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.3939 (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) = | 0.3348 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 27.1125 | 26.9502 | 26.7911 | 26.0440 | 25.9042 | 25.2535 | 25.2535 | 25.1329 | 25.5041 | 25.9042 | 26.1870 | 26.4826 (38) |
| Heat transfer coeff | 71.0367 | 70.8744 | 70.7154 | 69.9682 | 69.8285 | 69.1777 | 69.1777 | 69.0572 | 69.4284 | 69.8285 | 70.1112 | 70.4069 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 69.9676 (39) |
| HLP | 1.2445 | 1.2417 | 1.2389 | 1.2258 | 1.2233 | 1.2119 | 1.2119 | 1.2098 | 1.2163 | 1.2233 | 1.2283 | 1.2335 (40) |
| HLP (average) | | | | | | | | | | | | 1.2258 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| 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) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | |
|--|--------|--------|--------|--------|--------|----------|----------|----------|--------------------------|--------|--------|----------------|
| Space cooling | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 177.3573 | 215.6057 | 185.4818 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (104) |
| Cooled fraction | | | | | | | | | FC = cooled area / (4) = | | | 578.4448 (104) |
| Intermittency factor (Table 10b) | | | | | | | | | | | | 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 | 44.3393 | 53.9014 | 46.3705 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (107) |
| Space cooling per m2 | | | | | | | | | | | | 144.6112 (107) |
| Energy for space heating | | | | | | | | | | | | 2.5335 (108) |
| Energy for space cooling | | | | | | | | | | | | 43.2846 (99) |
| Total | | | | | | | | | | | | 2.5335 (108) |
| Dwelling Fabric Energy Efficiency (DFEE) | | | | | | | | | | | | 45.8181 (109) |
| | | | | | | | | | | | | 45.8 (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 (m ²) | Storey height (m) | Volume (m ³) |
|--|------------------------|---------------------------------|--------------------------|
| Ground floor | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m ³ per hour |
|---|--------------|-------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 2 * 10 = | 20.0000 (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) | | | | 20.0000 / (5) = | 0.1439 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | 0.3939 (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) = | | 0.3348 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.4269 | 0.4185 | 0.4101 | 0.3683 | 0.3599 | 0.3181 | 0.3181 | 0.3097 | 0.3348 | 0.3599 | 0.3767 | 0.3934 (22b) |
| | 0.5911 | 0.5876 | 0.5841 | 0.5678 | 0.5648 | 0.5506 | 0.5506 | 0.5480 | 0.5560 | 0.5648 | 0.5709 | 0.5774 (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 | | | | | |
|---|----------------------|-------------------------|------------------------|----------------------------|----------------------|-----------------------------|---------------|---------|---------|---------|---------|--------------|
| TER Opaque door | | | 1.9300 | 1.0000 | 1.9300 | | (26) | | | | | |
| TER Opening Type (Uw = 1.40) | | | 9.4500 | 1.3258 | 12.5284 | | (27) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1300 | 3.7102 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.1800 | 11.2176 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1300 | 3.7102 | | (30) | | | | | |
| Total net area of external elements Aum(A, m ²) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 33.0964 | (33) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K | | | | | | | 250.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 7.5342 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 40.6306 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | 27.1125 | 26.9502 | 26.7911 | 26.0440 | 25.9042 | 25.2535 | 25.2535 | 25.1329 | 25.5041 | 25.9042 | 26.1870 | 26.4826 (38) |
| Heat transfer coeff | 67.7431 | 67.5808 | 67.4217 | 66.6746 | 66.5348 | 65.8841 | 65.8841 | 65.7636 | 66.1347 | 66.5348 | 66.8176 | 67.1132 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 66.6739 (39) |
| HLP | 1.1868 | 1.1840 | 1.1812 | 1.1681 | 1.1656 | 1.1542 | 1.1542 | 1.1521 | 1.1586 | 1.1656 | 1.1706 | 1.1758 (40) |
| HLP (average) | | | | | | | | | | | | 1.1681 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (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 | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

| | | | | | | | | | | | | |
|--|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|--------|---------------|
| Intermittency factor (Table 10b) | 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 | 27.1644 | 39.0785 | 31.8443 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107) |
| Space cooling | | | | | | | | | | | | 98.0872 (107) |
| Space cooling per m2 | | | | | | | | | | | | 1.7184 (108) |
| Energy for space heating | | | | | | | | | | | | 42.9817 (99) |
| Energy for space cooling | | | | | | | | | | | | 1.7184 (108) |
| Total | | | | | | | | | | | | 44.7001 (109) |
| Target Fabric Energy Efficiency (TFEE) | | | | | | | | | | | | 51.4 (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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 74.0488 | 73.1952 | 73.4738 | 72.3955 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.1825 | 72.3955 | 72.3955 | 73.1952 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.3334 (39) |
| HLP | 1.2973 | 1.2823 | 1.2872 | 1.2683 | 1.2683 | 1.2471 | 1.2471 | 1.2431 | 1.2471 | 1.2683 | 1.2683 | 1.2823 (40) |
| HLP (average) | | | | | | | | | | | | 1.2672 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

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 | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) | | | | | | | |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) | | | | | | | |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) | | | | | | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | | 5.0000 | | | | | | | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) | | | | | | | |
| Wind speed | Jan 5.1000 | Feb 5.0000 | Mar 4.9000 | Apr 4.4000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 4.0000 | Oct 4.3000 | Nov 4.5000 | Dec 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 | | | | | |
|---|-------------|-------------|-------------|---------------|------------------------------|----------------|---------------|-------------|-------------|-------------|-------------|------------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) | | | | | |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) | | | | | |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = 38.8905 | | (33) | | | | | |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 100.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 5.0338 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 43.9243 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 30.7236 | Feb 30.4211 | Mar 30.1246 | Apr 28.7318 | May 28.4713 | Jun 27.2582 | Jul 27.2582 | Aug 27.0336 | Sep 27.7255 | Oct 28.4713 | Nov 28.9984 | Dec 29.5495 (38) |
| Heat transfer coeff | 74.6478 | 74.3453 | 74.0488 | 72.6561 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.6498 | 72.3955 | 72.9227 | 73.4738 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.6549 (39) |
| HLP | Jan 1.3078 | Feb 1.3025 | Mar 1.2973 | Apr 1.2729 | May 1.2683 | Jun 1.2471 | Jul 1.2471 | Aug 1.2431 | Sep 1.2553 | Oct 1.2683 | Nov 1.2776 | Dec 1.2872 (40) |
| HLP (average) | | | | | | | | | | | | 1.2729 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Water storage loss: | | | | | | | | | | | | |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|------------|--------------------------------|------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 37.2574 | (77) | | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 40.5522 | (77) | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7700 | 12.8629 | (81) | | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | (83) |
| Total gains | 527.7187 | 592.2188 | 645.4015 | 693.4074 | 721.0509 | 702.6288 | 672.6371 | 638.3133 | 603.2324 | 553.6979 | 513.2945 | 502.4750 | (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) | 0.9237 | 0.8990 | 0.8595 | 0.7891 | 0.6862 | 0.5487 | 0.4256 | 0.4593 | 0.6385 | 0.8103 | 0.8969 | 0.9306 | (86) |
| MIT | 18.7470 | 19.0243 | 19.4545 | 20.0035 | 20.4634 | 20.7879 | 20.9185 | 20.8992 | 20.6702 | 20.0851 | 19.3417 | 18.7090 | (87) |
| Th 2 | 19.8347 | 19.8389 | 19.8430 | 19.8621 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8761 | 19.8657 | 19.8585 | 19.8509 | (88) |
| util rest of house | 0.9127 | 0.8848 | 0.8393 | 0.7579 | 0.6376 | 0.4758 | 0.3306 | 0.3642 | 0.5700 | 0.7755 | 0.8802 | 0.9206 | (89) |
| MIT 2 | 16.8879 | 17.2845 | 17.8962 | 18.6710 | 19.2869 | 19.6977 | 19.8324 | 19.8197 | 19.5663 | 18.8027 | 17.7573 | 16.8429 | (90) |
| Living area fraction | 17.4712 | 17.8304 | 18.3852 | 19.0891 | 19.6561 | 20.0397 | 20.1732 | 20.1585 | 19.9127 | 19.2051 | 18.2544 | 17.4285 | (92) |
| MIT | 17.4712 | 17.8304 | 18.3852 | 19.0891 | 19.6561 | 20.0397 | 20.1732 | 20.1585 | 19.9127 | 19.2051 | 18.2544 | 17.4285 | (92) |
| Temperature adjustment | 17.3212 | 17.6804 | 18.2352 | 18.9391 | 19.5061 | 19.8897 | 20.0232 | 20.0085 | 19.7627 | 19.0551 | 18.1044 | 17.2785 | (93) |
| adjusted MIT | 17.3212 | 17.6804 | 18.2352 | 18.9391 | 19.5061 | 19.8897 | 20.0232 | 20.0085 | 19.7627 | 19.0551 | 18.1044 | 17.2785 | (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Useful gains | 464.7593 | 503.6492 | 519.2133 | 505.0089 | 447.3155 | 334.6927 | 230.8343 | 239.5943 | 339.1938 | 412.8948 | 434.5250 | 447.2053 | (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 | 972.0055 | 950.1657 | 868.9748 | 729.3997 | 565.1244 | 376.5362 | 243.6704 | 256.0485 | 405.7301 | 612.1125 | 802.4717 | 960.9235 | (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 | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 | (98) |
| Space heating | | | | | | | | | | | | 1982.2300 | (98) |
| Space heating per m2 | | | | | | | | | | | | 34.7272 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

| | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 2190.3094 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 | (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | 417.0068 | 331.5570 | 287.5387 | 178.5209 | 96.8507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 163.7768 | 292.7311 | 422.3275 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) |
| Efficiency of water heater (217)m | 89.5959 | 89.5308 | 89.4043 | 89.1396 | 88.6796 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.0423 | 89.4272 | 87.3000 | (216) |
| Fuel for water heating, kWh/month | 159.9958 | 140.4653 | 146.1882 | 129.3006 | 125.8102 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.3370 | 144.1131 | 155.3854 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1590.7175 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | 2190.3094 (211) |
| Space heating fuel - main system | | | | | | | | | | | | | 0.0000 (215) |
| Space heating fuel - secondary | | | | | | | | | | | | | |
| 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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 4126.1307 (238) |

10a. Fuel costs - using Table 12 prices

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|-------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 2190.3094 | 3.4800 | 76.2228 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 1590.7175 | 3.4800 | 55.3570 (247) |
| Pumps and fans for heating | 75.0000 | 13.1900 | 9.8925 (249) |
| Energy for lighting | 270.1038 | 13.1900 | 35.6267 (250) |
| Additional standing charges | | | 120.0000 (251) |
| Total energy cost | | | 297.0989 (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|---|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | $[(255) \times (256)] / [(4) + 45.0] =$ | 1.2224 (257) |
| SAP value | | 82.9477 |
| SAP rating (Section 12) | | 83 (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 | 2190.3094 | 0.2160 | 473.1068 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1590.7175 | 0.2160 | 343.5950 (264) |
| Space and water heating | | | 816.7018 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total kg/year | | | 995.8107 (272) |
| CO2 emissions per m2 | | | 17.4500 (273) |
| EI value | | | 86.9280 |
| EI rating | | | 87 (274) |
| EI band | | | B |

Calculation of stars for heating and DHW

| | |
|------------------------------------|---|
| Main heating energy efficiency | $3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4 |
| Main heating environmental impact | $0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4 |
| Water heating energy efficiency | $3.48 / 0.8864 = 3.926$, stars = 4 |
| Water heating environmental impact | $0.216 / 0.8864 = 0.2437$, 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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | Yes | |
| Measured/design AP50 | | | | 5.0000 | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 4.9000 | 4.6000 | 4.7000 | 4.3000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 3.8000 | 4.3000 | 4.3000 | 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 30.1246 | 29.2710 | 29.5495 | 28.4713 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.2582 | 28.4713 | 28.4713 | 29.2710 (38) |
| Heat transfer coeff | 74.0488 | 73.1952 | 73.4738 | 72.3955 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.1825 | 72.3955 | 72.3955 | 73.1952 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.3334 (39) |
| HLP | 1.2973 | 1.2823 | 1.2872 | 1.2683 | 1.2683 | 1.2471 | 1.2471 | 1.2431 | 1.2471 | 1.2683 | 1.2683 | 1.2823 (40) |
| HLP (average) | | | | | | | | | | | | 1.2672 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------|----------|----------|----------|----------|------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | 139.2606 | (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (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 Specific data or Table 6c | Access factor Table 6d | Gains W | | | | | | |
|-------------|----------|--------------------------|---------------------------|-----------------------------|------------------------------|------------------------|----------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 | (77) | | | | | | |
| Southeast | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 | (77) | | | | | | |
| Northwest | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 | (81) | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 | (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 | (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) | 21.4123 | 21.6620 | 21.5799 | 21.9013 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.2745 | 21.9013 | 21.9013 | 21.6620 | 21.0000 | (85) |
| tau | 2.4275 | 2.4441 | 2.4387 | 2.4601 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4850 | 2.4601 | 2.4601 | 2.4441 | | |
| alpha | 0.9132 | 0.8908 | 0.8453 | 0.7660 | 0.6598 | 0.5013 | 0.4042 | 0.4195 | 0.6040 | 0.7883 | 0.9224 | 0.9215 | (86) | |
| util living area | 18.9286 | 19.1601 | 19.5901 | 20.1123 | 20.5381 | 20.8384 | 20.9292 | 20.9234 | 20.7263 | 20.1907 | 19.2822 | 18.8884 | (87) | |
| MIT | 19.8430 | 19.8547 | 19.8509 | 19.8657 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8825 | 19.8657 | 19.8657 | 19.8547 | (88) | |
| util rest of house | 0.9006 | 0.8754 | 0.8231 | 0.7320 | 0.6072 | 0.4260 | 0.3103 | 0.3234 | 0.5322 | 0.7494 | 0.9083 | 0.9100 | (89) | |
| MIT 2 | 17.1530 | 17.4870 | 18.0911 | 18.8193 | 19.3812 | 19.7497 | 19.8404 | 19.8397 | 19.6344 | 18.9447 | 17.6854 | 17.1035 | (90) | |
| Living area fraction | 17.7101 | 18.0120 | 18.5615 | 19.2250 | 19.7442 | 20.0913 | 20.1821 | 20.1798 | 19.9770 | 19.3357 | 18.1864 | 17.6636 | (91) | |
| MIT | 17.5601 | 17.8620 | 18.4115 | 19.0750 | 19.5942 | 19.9413 | 20.0321 | 20.0298 | 19.8270 | 19.1857 | 18.0364 | 17.5136 | (92) | |
| Temperature adjustment | | | | | | | | | | | | | -0.1500 | |
| adjusted MIT | | | | | | | | | | | | | 17.5136 | (93) |

8. Space heating requirement

| Utilisation | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|--------------|---------|------|
| Useful gains | 0.8676 | 0.8411 | 0.7889 | 0.7047 | 0.5933 | 0.4302 | 0.3235 | 0.3365 | 0.5283 | 0.7218 | 0.8771 | 0.8782 | (94) | | |
| Ext temp. | 471.7935 | 504.5846 | 519.6048 | 507.5883 | 434.7525 | 320.7479 | 226.2617 | 224.4397 | 331.8682 | 409.7730 | 365.3992 | 450.6338 | (95) | | |
| Heat loss rate W | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 | (96) | | |
| Month fracti | 937.4667 | 919.4758 | 838.4438 | 707.6681 | 535.3076 | 351.7370 | 237.1839 | 236.2722 | 386.3094 | 585.3657 | 741.0726 | 923.2534 | (97) | | |
| Space heating kWh | 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 | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 | (98) | | |
| Space heating per m2 | | | | | | | | | | | | 1834.1093 | (98) | | |
| | | | | | | | | | | | | | (98) / (4) = | 32.1323 | (99) |

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

| | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | | 2026.6401 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 | (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| Space heating fuel (main heating system) | 382.8296 | 308.0739 | 262.1174 | 159.1795 | 82.6663 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 144.3547 | 298.8783 | 388.5403 | (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 | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | (64) |
| Efficiency of water heater (217)m | 89.5395 | 89.4804 | 89.3367 | 89.0492 | 88.5569 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 88.9417 | 89.4420 | 87.3000 | (216) |
| Fuel for water heating, kWh/month | 160.0967 | 140.5443 | 146.2989 | 129.4318 | 125.9845 | 111.9246 | 105.3415 | 118.5642 | 119.2916 | 134.4890 | 144.0893 | 155.4793 | (219) |
| Water heating fuel used | | | | | | | | | | | | | 1591.5356 (219) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | | 2026.6401 (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) | | | | | | | | | | | | | 270.1038 (232) |
| Total delivered energy for all uses | | | | | | | | | | | | | 3963.2795 (238) |

10a. Fuel costs - using BEDF prices (485)

| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|-------------------------------|---------------|------------------|------------------|
| Space heating - main system 1 | 2026.6401 | 3.7400 | 75.7963 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 1591.5356 | 3.7400 | 59.5234 (247) |
| Pumps and fans for heating | 75.0000 | 19.1200 | 14.3400 (249) |
| Energy for lighting | 270.1038 | 19.1200 | 51.6438 (250) |
| Additional standing charges | | | 94.0000 (251) |
| Total energy cost | | | 295.3036 (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 | 2026.6401 | 0.2160 | 437.7543 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1591.5356 | 0.2160 | 343.7717 (264) |
| Space and water heating | | | 781.5259 (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Total kg/year | | | 960.6348 (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 | 2026.6401 | 1.2200 | 2472.5009 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 1591.5356 | 1.2200 | 1941.6735 (264) |
| Space and water heating | | | 4414.1743 (265) |
| Pumps and fans | 75.0000 | 3.0700 | 230.2500 (267) |
| Energy for lighting | 270.1038 | 3.0700 | 829.2187 (268) |
| Primary energy kWh/year | | | 5473.6430 (272) |
| Primary energy kWh/m2/year | | | 95.8942 (273) |

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
 Current environmental impact rating: B 87

(For testing purposes):

A Not considered
 B Not considered

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | |
|----|---------------------------|-------------------|
| 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 | Recommended |
| 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 | + 1.4 | -£ 23 | -162 kg (16.9%) |
| U Solar photovoltaic panels | + 13.1 | -£ 349 | -946 kg (118.5%) |

| Recommended measures | Typical annual savings | | Energy efficiency | Environmental impact |
|---------------------------|------------------------|-------------------------------|-------------------|----------------------|
| Solar water heating | £23 | 2.84 kg/m ² | B 84 | B 89 |
| Solar photovoltaic panels | £349 | 16.58 kg/m ² | A 97 | A 101 |
| Total Savings | £372 | 19.42 kg/m² | | |

Potential energy efficiency rating: A 97
 Potential environmental impact rating: A 101

Fuel prices for cost data on this page from database revision number 485 TEST (29 Oct 2021)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

| | Current | Potential | Saving |
|----------------------------------|-----------------------|------------------------|------------------------|
| Electricity | £66 | £76 | -£10 |
| Mains gas | £229 | £197 | £33 |
| Space heating | £184 | £184 | £0 |
| Water heating | £60 | £37 | £23 |
| Lighting | £52 | £52 | £0 |
| Generated (PV) | -£0 | -£349 | £349 |
| Total cost of fuels | £295 | -£76 | £372 |
| Total cost of uses | £296 | -£76 | £372 |
| Delivered energy | 69 kWh/m ² | 23 kWh/m ² | 46 kWh/m ² |
| Carbon dioxide emissions | 1.0 tonnes | -0.1 tonnes | 1.1 tonnes |
| CO2 emissions per m ² | 17 kg/m ² | -3 kg/m ² | 19 kg/m ² |
| Primary energy | 96 kWh/m ² | -18 kWh/m ² | 114 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 (m2) | Storey height (m) | Volume (m3) |
|--|--------------|-------------------|--|
| Ground floor | 28.5400 (1b) | 2.3100 (2b) | 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | 2.5600 (2c) | 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) |
| Pressure test | | | | | Yes |
| Measured/design AP50 | | | | | 5.0000 |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5828 | 0.5714 | 0.5600 | 0.5028 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4571 | 0.4914 | 0.5143 | 0.5371 (22b) |
| | 0.6698 | 0.6633 | 0.6568 | 0.6264 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.6045 | 0.6207 | 0.6322 | 0.6442 (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 |
|--|----------|-------------|------------|---------------|----------------------|----------------|------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
 Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.0338 (36)
 Total fabric heat loss (33) + (36) = 43.9243 (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) | | | | | | | | | | | | |
| (38)m | 30.7236 | 30.4211 | 30.1246 | 28.7318 | 28.4713 | 27.2582 | 27.2582 | 27.0336 | 27.7255 | 28.4713 | 28.9984 | 29.5495 (38) |
| Heat transfer coeff | 74.6478 | 74.3453 | 74.0488 | 72.6561 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.6498 | 72.3955 | 72.9227 | 73.4738 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.6549 (39) |
| HLP | 1.3078 | 1.3025 | 1.2973 | 1.2729 | 1.2683 | 1.2471 | 1.2471 | 1.2431 | 1.2553 | 1.2683 | 1.2776 | 1.2872 (40) |
| HLP (average) | | | | | | | | | | | | 1.2729 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------|-----------------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | | (57) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | | (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 | | | | | | | | | | | | | | 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 | | | | | | | | | | | | | | 1.4540 (H8) |
| Utilisation factor | | | | | | | | | | | | | | 0.4973 (H9) |
| Collector performance factor | | | | | | | | | | | | | | 0.8793 (H10) |
| Dedicated solar storage volume | | | | | | | | | | | | | | 75.0000 (H11) |
| Effective solar volume | | | | | | | | | | | | | | 75.0000 (H13) |
| Daily hot water demand | | | | | | | | | | | | | | 79.2773 (H14) |
| Volume ratio Veff/V | | | | | | | | | | | | | | 0.9460 (H15) |
| Solar storage volume factor | | | | | | | | | | | | | | 0.9889 (H16) |
| Solar input | | | | | | | | | | | | | | -784.2477 (H17) |
| Solar input | -22.7416 | -37.9492 | -64.6319 | -86.6194 | -107.0110 | -105.2089 | -103.8185 | -90.7068 | -71.0416 | -48.5130 | -26.9748 | -19.0309 | | (63) |
| Solar input (sum of months) = Sum(63)m = | | | | | | | | | | | | | | -784.2477 (63) |
| Output from w/h | 120.6081 | 87.8104 | 66.0667 | 28.6385 | 4.5569 | 0.0000 | 0.0000 | 12.7998 | 33.1000 | 71.1038 | 101.9015 | 120.2297 | | (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | | | 646.8155 (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | (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) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | (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 | | | | | | | |
|-------------|----------|--------------------------|-----------------------------|------------------------------|------------------------|--------------|----------|----------|----------|----------|----------|----------|------|
| Southeast | 2.9400 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 37.2574 (77) | | | | | | | |
| Southeast | 3.2000 | 36.7938 | 0.7100 | 0.7000 | 0.7700 | 40.5522 (77) | | | | | | | |
| Northwest | 3.3100 | 11.2829 | 0.7100 | 0.7000 | 0.7700 | 12.8629 (81) | | | | | | | |
| Solar gains | 90.6725 | 158.7214 | 228.5181 | 302.1671 | 355.8148 | 360.8789 | 344.7475 | 303.5564 | 253.8395 | 178.4808 | 109.3828 | 77.0933 | (83) |
| Total gains | 527.7187 | 592.2188 | 645.4015 | 693.4074 | 721.0509 | 702.6288 | 672.6371 | 638.3133 | 603.2324 | 553.6979 | 513.2945 | 502.4750 | (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 | 21.2405 | 21.3269 | 21.4123 | 21.8227 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.1293 | 21.9013 | 21.7430 | 21.5799 | |
| alpha | 2.4160 | 2.4218 | 2.4275 | 2.4548 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4753 | 2.4601 | 2.4495 | 2.4387 | |
| util living area | 0.9237 | 0.8990 | 0.8595 | 0.7891 | 0.6862 | 0.5487 | 0.4256 | 0.4593 | 0.6385 | 0.8103 | 0.8969 | 0.9306 | (86) |
| MIT | 18.7470 | 19.0243 | 19.4545 | 20.0035 | 20.4634 | 20.7879 | 20.9185 | 20.8992 | 20.6702 | 20.0851 | 19.3417 | 18.7090 | (87) |
| Th 2 | 19.8347 | 19.8389 | 19.8430 | 19.8621 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8761 | 19.8657 | 19.8585 | 19.8509 | (88) |
| util rest of house | 0.9127 | 0.8848 | 0.8393 | 0.7579 | 0.6376 | 0.4758 | 0.3306 | 0.3642 | 0.5700 | 0.7755 | 0.8802 | 0.9206 | (89) |
| MIT 2 | 16.8879 | 17.2845 | 17.8962 | 18.6710 | 19.2869 | 19.6977 | 19.8324 | 19.8197 | 19.5663 | 18.8027 | 17.7573 | 16.8429 | (90) |
| Living area fraction | | | | | | | | | | | | | 0.3138 (91) |
| MIT | 17.4712 | 17.8304 | 18.3852 | 19.0891 | 19.6561 | 20.0397 | 20.1732 | 20.1585 | 19.9127 | 19.2051 | 18.2544 | 17.4285 | (92) |
| Temperature adjustment | | | | | | | | | | | | | -0.1500 |
| adjusted MIT | 17.3212 | 17.6804 | 18.2352 | 18.9391 | 19.5061 | 19.8897 | 20.0232 | 20.0085 | 19.7627 | 19.0551 | 18.1044 | 17.2785 | (93) |

8. Space heating requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation | 0.8807 | 0.8504 | 0.8045 | 0.7283 | 0.6204 | 0.4763 | 0.3432 | 0.3754 | 0.5623 | 0.7457 | 0.8465 | 0.8900 (94) |
| Useful gains | 464.7593 | 503.6492 | 519.2133 | 505.0089 | 447.3155 | 334.6927 | 230.8343 | 239.5943 | 339.1938 | 412.8948 | 434.5250 | 447.2053 (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 | | | | | | | | | | | | |
| Month fracti | 972.0055 | 950.1657 | 868.9748 | 729.3997 | 565.1244 | 376.5362 | 243.6704 | 256.0485 | 405.7301 | 612.1125 | 802.4717 | 960.9235 (97) |
| Space heating kWh | 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 | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 (98) |
| Space heating per m2 | | | | | | | | | | | | 1982.2300 (98) |
| | | | | | | | | | | | | (98) / (4) = 34.7272 (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) | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | 2190.3094 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating requirement | 377.3912 | 300.0591 | 260.2226 | 161.5614 | 87.6499 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 148.2180 | 264.9216 | 382.2063 (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 (210) |
| Space heating fuel (main heating system) | 417.0068 | 331.5570 | 287.5387 | 178.5209 | 96.8507 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 163.7768 | 292.7311 | 422.3275 (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 | 120.6081 | 87.8104 | 66.0667 | 28.6385 | 4.5569 | 0.0000 | 0.0000 | 12.7998 | 33.1000 | 71.1038 | 101.9015 | 120.2297 (64) |
| Efficiency of water heater | 89.7037 | 89.7552 | 89.8333 | 90.0033 | 90.3364 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.4372 | 89.5878 | 87.3000 (216) |
| (217)m | 89.7037 | 89.7552 | 89.8333 | 90.0033 | 90.3364 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.4372 | 89.5878 | 89.7131 (217) |
| Fuel for water heating, kWh/month | 134.4517 | 97.8333 | 73.5437 | 31.8194 | 5.0444 | 0.0000 | 0.0000 | 14.6619 | 37.9153 | 79.5014 | 113.7449 | 134.0158 (219) |
| Water heating fuel used | | | | | | | | | | | | 722.5317 (219) |
| Annual totals kWh/year | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | 2190.3094 (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) |
| pump for solar water heating | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 125.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 270.1038 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = | | | | | | | | | | -1727.2394 | | -1727.2394 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | 1580.7055 (238) |

10a. Fuel costs - using Table 12 prices

| | | | |
|---------------------------------------|---------------|------------------|------------------|
| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
| Space heating - main system 1 | 2190.3094 | 3.4800 | 76.2228 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 722.5317 | 3.4800 | 25.1441 (247) |
| 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 | 270.1038 | 13.1900 | 35.6267 (250) |
| Additional standing charges | | | 120.0000 (251) |
| Energy saving/generation technologies | | | |
| PV Unit | -1727.2394 | 13.1900 | -227.8229 (252) |
| Total energy cost | | | 45.6582 (255) |

11a. SAP rating - Individual heating systems

| | | |
|----------------------------------|----------------------------------|--------------|
| Energy cost deflator (Table 12): | | 0.4200 (256) |
| Energy cost factor (ECF) | [(255) x (256)] / [(4) + 45.0] = | 0.1879 (257) |
| SAP value | | 97.3794 |
| SAP rating (Section 12) | | 97 (258) |
| SAP band | | A |

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 | 2190.3094 | 0.2160 | 473.1068 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 722.5317 | 0.2160 | 156.0668 (264) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

| | | | |
|---------------------------------------|------------|--------|-----------------|
| Space and water heating | | | 629.1737 (265) |
| Pumps and fans | 125.0000 | 0.5190 | 64.8750 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1727.2394 | 0.5190 | -896.4372 (269) |
| Total kg/year | | | -62.2047 (272) |
| CO2 emissions per m2 | | | -1.0900 (273) |
| EI value | | | 100.8166 |
| EI rating | | | 101 (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 | 28.5400 (1b) | x 2.3100 (2b) | = 65.9274 (1b) - (3b) |
| First floor | 28.5400 (1c) | x 2.5600 (2c) | = 73.0624 (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0800 | | (4) |
| Dwelling volume | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.9898 (5) |

2. Ventilation rate

| | main heating | secondary heating | other | total | m3 per hour | | | | | | | |
|---|--------------|-------------------|-----------------------------|-----------------|--------------|------------|------------|------------|------------|------------|------------|-----------------|
| Number of chimneys | 0 | 0 | 0 | 0 * 40 = | 0.0000 (6a) | | | | | | | |
| Number of open flues | 0 | 0 | 0 | 0 * 20 = | 0.0000 (6b) | | | | | | | |
| Number of intermittent fans | | | | 4 * 10 = | 40.0000 (7a) | | | | | | | |
| Number of passive vents | | | | 0 * 10 = | 0.0000 (7b) | | | | | | | |
| Number of flueless gas fires | | | | 0 * 40 = | 0.0000 (7c) | | | | | | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) | | | | 40.0000 / (5) = | 0.2878 (8) | | | | | | | |
| Pressure test | | | | Yes | | | | | | | | |
| Measured/design AP50 | | | | 5.0000 | | | | | | | | |
| Infiltration rate | | | | | 0.5378 (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) = | | 0.4571 (21) | | | | | | | |
| Wind speed | Jan 4.9000 | Feb 4.6000 | Mar 4.7000 | Apr 4.3000 | May 4.3000 | Jun 3.8000 | Jul 3.8000 | Aug 3.7000 | Sep 3.8000 | Oct 4.3000 | Nov 4.3000 | Dec 4.6000 (22) |
| Wind factor | 1.2250 | 1.1500 | 1.1750 | 1.0750 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 0.9500 | 1.0750 | 1.0750 | 1.1500 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| Effective ac | 0.5600 | 0.5257 | 0.5371 | 0.4914 | 0.4914 | 0.4343 | 0.4343 | 0.4228 | 0.4343 | 0.4914 | 0.4914 | 0.5257 (22b) |
| | 0.6568 | 0.6382 | 0.6442 | 0.6207 | 0.6207 | 0.5943 | 0.5943 | 0.5894 | 0.5943 | 0.6207 | 0.6207 | 0.6382 (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 | | | | | |
|---|-------------|-------------|-------------|---------------|----------------------|----------------|---------------|-------------|-------------|-------------|-------------|------------------|
| French Door (Uw = 1.41) | | | 2.9400 | 1.3347 | 3.9241 | | (27) | | | | | |
| Window (Uw = 1.41) | | | 6.5100 | 1.3347 | 8.6890 | | (27) | | | | | |
| Solid door tall window | | | 1.9300 | 1.2000 | 2.3160 | | (26) | | | | | |
| Heat Loss Floor 1 | | | 28.5400 | 0.1500 | 4.2810 | | (28a) | | | | | |
| External Wall 1 | 73.7000 | 11.3800 | 62.3200 | 0.2700 | 16.8264 | | (29a) | | | | | |
| External Roof 1 | 28.5400 | | 28.5400 | 0.1000 | 2.8540 | | (30) | | | | | |
| Total net area of external elements Aum(A, m2) | | | 130.7800 | | | | (31) | | | | | |
| Fabric heat loss, W/K = Sum (A x U) | | | | | (26)...(30) + (32) = | 38.8905 | (33) | | | | | |
| Party Wall 1 | | | 34.8000 | 0.0000 | 0.0000 | | (32) | | | | | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | | | | | | 100.0000 (35) | | | | | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | | | | | 5.0338 (36) | | | | | |
| Total fabric heat loss | | | | | | (33) + (36) = | 43.9243 (37) | | | | | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | | | | | | | | | | | | |
| (38)m | Jan 30.1246 | Feb 29.2710 | Mar 29.5495 | Apr 28.4713 | May 28.4713 | Jun 27.2582 | Jul 27.2582 | Aug 27.0336 | Sep 27.2582 | Oct 28.4713 | Nov 28.4713 | Dec 29.2710 (38) |
| Heat transfer coeff | 74.0488 | 73.1952 | 73.4738 | 72.3955 | 72.3955 | 71.1825 | 71.1825 | 70.9579 | 71.1825 | 72.3955 | 72.3955 | 73.1952 (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.3334 (39) |
| HLP | Jan 1.2973 | Feb 1.2823 | Mar 1.2872 | Apr 1.2683 | May 1.2683 | Jun 1.2471 | Jul 1.2471 | Aug 1.2431 | Sep 1.2471 | Oct 1.2683 | Nov 1.2683 | Dec 1.2823 (40) |
| HLP (average) | | | | | | | | | | | | 1.2672 (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 | | | | | | | | | | | | 1.8980 (42) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 79.2773 (43) |
| Daily hot water use | 87.2050 | 84.0339 | 80.8628 | 77.6917 | 74.5206 | 71.3495 | 71.3495 | 74.5206 | 77.6917 | 80.8628 | 84.0339 | 87.2050 (44) |
| Energy conte | 129.3225 | 113.1063 | 116.7155 | 101.7554 | 97.6368 | 84.2531 | 78.0729 | 89.5898 | 90.6598 | 105.6552 | 115.3309 | 125.2419 (45) |
| Energy content (annual) | | | | | | | | | | | | Total = Sum(45)m = 1247.3400 (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | |
| Water storage loss: | 19.3984 | 16.9659 | 17.5073 | 15.2633 | 14.6455 | 12.6380 | 11.7109 | 13.4385 | 13.5990 | 15.8483 | 17.2996 | 18.7863 (46) |
| Total storage loss | | | | | | | | | | | | |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | | | |
|---|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------------|
| 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 | (56) |
| Combi loss | 14.0272 | 12.6534 | 13.9831 | 13.5025 | 13.9312 | 13.4571 | 13.8903 | 13.9168 | 13.4818 | 13.9616 | 13.5454 | 14.0187 | 14.0187 | (61) |
| Total heat required for water heating calculated for each month | 143.3497 | 125.7597 | 130.6986 | 115.2580 | 111.5679 | 97.7102 | 91.9631 | 103.5066 | 104.1416 | 119.6168 | 128.8763 | 139.2606 | 139.2606 | (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 | | | | | | | | | | | | | | 1139.7099 (H5) |
| Overshading factor | | | | | | | | | | | | | | 0.8000 (H6) |
| Solar energy available | | | | | | | | | | | | | | 1914.7126 (H7) |
| Adjustment factor for showers | | | | | | | | | | | | | | 1.0000 (H7a) |
| Solar-to-load ratio | | | | | | | | | | | | | | 1.5350 (H8) |
| Utilisation factor | | | | | | | | | | | | | | 0.4787 (H9) |
| Collector performance factor | | | | | | | | | | | | | | 0.8793 (H10) |
| Dedicated solar storage volume | | | | | | | | | | | | | | 75.0000 (H11) |
| Effective solar volume | | | | | | | | | | | | | | 75.0000 (H13) |
| Daily hot water demand | | | | | | | | | | | | | | 79.2773 (H14) |
| Volume ratio Veff/V | | | | | | | | | | | | | | 0.9460 (H15) |
| Solar storage volume factor | | | | | | | | | | | | | | 0.9889 (H16) |
| Solar input | | | | | | | | | | | | | | -797.0145 (H17) |
| Solar input | -26.1366 | -38.8057 | -66.4777 | -91.2580 | -106.5291 | -113.2936 | -107.7339 | -95.8834 | -75.7071 | -50.9881 | -3.0549 | -21.1463 | -21.1463 | (63) |
| Solar input (sum of months) = Sum (63)m = | | | | | | | | | | | | | | -797.0145 (63) |
| Output from w/h | 117.2131 | 86.9540 | 64.2209 | 24.0000 | 5.0389 | 0.0000 | 0.0000 | 7.6232 | 28.4345 | 68.6287 | 125.8214 | 118.1143 | 118.1143 | (64) |
| Total per year (kWh/year) = Sum (64)m = | | | | | | | | | | | | | | 646.0488 (64) |
| Heat gains from water heating, kWh/month | 46.5065 | 40.7712 | 42.3037 | 37.2093 | 35.9470 | 31.3784 | 29.4318 | 33.2678 | 33.5148 | 38.6208 | 41.7339 | 45.1476 | 45.1476 | (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 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 | 113.8794 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 38.2360 | 33.9609 | 27.6188 | 20.9092 | 15.6299 | 13.1954 | 14.2581 | 18.5332 | 24.8753 | 31.5849 | 36.8642 | 39.2987 | 39.2987 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 247.0557 | 249.6194 | 243.1591 | 229.4057 | 212.0446 | 195.7276 | 184.8269 | 182.2632 | 188.7236 | 202.4769 | 219.8380 | 236.1550 | 236.1550 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 | 48.2859 (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 | 3.0000 (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 | -75.9196 (71) |
| Water heating gains (Table 5) | 62.5088 | 60.6714 | 56.8598 | 51.6796 | 48.3159 | 43.5811 | 39.5589 | 44.7148 | 46.5484 | 51.9096 | 57.9637 | 60.6823 | 60.6823 (72) |
| Total internal gains | 437.0462 | 433.4974 | 416.8834 | 391.2403 | 365.2361 | 341.7499 | 327.8896 | 334.7570 | 349.3929 | 375.2171 | 403.9117 | 425.3817 | 425.3817 (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 | | | | | | | |
| Southeast | 2.9400 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 43.6017 (77) | | | | | | | |
| Southeast | 3.2000 | 43.0593 | 0.7100 | 0.7000 | 0.7700 | 47.4577 (77) | | | | | | | |
| Northwest | 3.3100 | 13.7804 | 0.7100 | 0.7000 | 0.7700 | 15.7101 (81) | | | | | | | |
| Solar gains | 106.7695 | 166.4108 | 241.7405 | 329.0942 | 367.5431 | 403.7764 | 371.5080 | 332.2885 | 278.7600 | 192.5017 | 12.6930 | 87.7686 | 87.7686 (83) |
| Total gains | 543.8158 | 599.9083 | 658.6239 | 720.3344 | 732.7792 | 745.5263 | 699.3976 | 667.0454 | 628.1529 | 567.7188 | 416.6047 | 513.1503 | 513.1503 (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 | 21.4123 | 21.6620 | 21.5799 | 21.9013 | 21.9013 | 22.2745 | 22.2745 | 22.3450 | 22.2745 | 21.9013 | 21.9013 | 21.6620 | 21.6620 | |
| alpha | 2.4275 | 2.4441 | 2.4387 | 2.4601 | 2.4601 | 2.4850 | 2.4850 | 2.4897 | 2.4850 | 2.4601 | 2.4601 | 2.4441 | 2.4441 | |
| util living area | 0.9132 | 0.8908 | 0.8453 | 0.7660 | 0.6598 | 0.5013 | 0.4042 | 0.4195 | 0.6040 | 0.7883 | 0.9224 | 0.9215 | 0.9215 (86) | |
| MIT | 18.9286 | 19.1601 | 19.5901 | 20.1123 | 20.5381 | 20.8384 | 20.9292 | 20.9234 | 20.7263 | 20.1907 | 19.2822 | 18.8884 | 18.8884 (87) | |
| Th 2 | 19.8430 | 19.8547 | 19.8509 | 19.8657 | 19.8657 | 19.8825 | 19.8825 | 19.8857 | 19.8825 | 19.8657 | 19.8657 | 19.8547 | 19.8547 (88) | |
| util rest of house | 0.9006 | 0.8754 | 0.8231 | 0.7320 | 0.6072 | 0.4260 | 0.3103 | 0.3234 | 0.5322 | 0.7494 | 0.9083 | 0.9100 | 0.9100 (89) | |
| MIT 2 | 17.1530 | 17.4870 | 18.0911 | 18.8193 | 19.3812 | 19.7497 | 19.8404 | 19.8397 | 19.6344 | 18.9447 | 17.6854 | 17.1035 | 17.1035 (90) | |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.3138 | 0.3138 (91) | |
| MIT | 17.7101 | 18.0120 | 18.5615 | 19.2250 | 19.7442 | 20.0913 | 20.1821 | 20.1798 | 19.9770 | 19.3357 | 18.1864 | 17.6636 | 17.6636 (92) | |
| Temperature adjustment | | | | | | | | | | | | -0.1500 | -0.1500 | |
| adjusted MIT | 17.5601 | 17.8620 | 18.4115 | 19.0750 | 19.5942 | 19.9413 | 20.0321 | 20.0298 | 19.8270 | 19.1857 | 18.0364 | 17.5136 | 17.5136 (93) | |

8. Space heating requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

| | | | | | | | | | | | | |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation | 0.8676 | 0.8411 | 0.7889 | 0.7047 | 0.5933 | 0.4302 | 0.3235 | 0.3365 | 0.5283 | 0.7218 | 0.8771 | 0.8782 (94) |
| Useful gains | 471.7935 | 504.5846 | 519.6048 | 507.5883 | 434.7525 | 320.7479 | 226.2617 | 224.4397 | 331.8682 | 409.7730 | 365.3992 | 450.6338 (95) |
| Ext temp. | 4.9000 | 5.3000 | 7.0000 | 9.3000 | 12.2000 | 15.0000 | 16.7000 | 16.7000 | 14.4000 | 11.1000 | 7.8000 | 4.9000 (96) |
| Heat loss rate W | | | | | | | | | | | | |
| | 937.4667 | 919.4758 | 838.4438 | 707.6681 | 535.3076 | 351.7370 | 237.1839 | 236.2722 | 386.3094 | 585.3657 | 741.0726 | 923.2534 (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 | | | | | | | | | | | | |
| | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 (98) |
| Space heating | | | | | | | | | | | | 1834.1093 (98) |
| Space heating per m2 | | | | | | | | | | | | (98) / (4) = 32.1323 (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) | | | | | | | | | | | | 0.0000 (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 90.5000 (206) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 (208) |
| Space heating requirement | | | | | | | | | | | | 2026.6401 (211) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating requirement | 346.4608 | 278.8069 | 237.2163 | 144.0575 | 74.8130 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 130.6410 | 270.4848 | 351.6290 (98) |
| Space heating efficiency (main heating system 1) | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 (210) |
| Space heating fuel (main heating system) | 382.8296 | 308.0739 | 262.1174 | 159.1795 | 82.6663 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 144.3547 | 298.8783 | 388.5403 (211) |
| Water heating requirement | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | 117.2131 | 86.9540 | 64.2209 | 24.0000 | 5.0389 | 0.0000 | 0.0000 | 7.6232 | 28.4345 | 68.6287 | 125.8214 | 118.1143 (64) |
| Efficiency of water heater | 89.6691 | 89.7182 | 89.7987 | 90.0287 | 90.2912 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.3718 | 89.4589 | 87.3000 (216) |
| (217)m | 89.6691 | 89.7182 | 89.7987 | 90.0287 | 90.2912 | 87.3000 | 87.3000 | 87.3000 | 87.3000 | 89.3718 | 89.4589 | 89.6735 (217) |
| Fuel for water heating, kWh/month | 130.7173 | 96.9190 | 71.5165 | 26.6581 | 5.5807 | 0.0000 | 0.0000 | 8.7321 | 32.5710 | 76.7901 | 140.6472 | 131.7159 (219) |
| Water heating fuel used | | | | | | | | | | | | 721.8480 (211) |
| Annual totals kWh/year | | | | | | | | | | | | |
| Space heating fuel - main system | | | | | | | | | | | | 2026.6401 (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) |
| pump for solar water heating | | | | | | | | | | | | 50.0000 (230g) |
| Total electricity for the above, kWh/year | | | | | | | | | | | | 125.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | | | | | | | | | | | | 270.1038 (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | | | | | | | | | | | |
| PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = | | | | | | | | | -1823.5358 | | | -1823.5358 (233) |
| Total delivered energy for all uses | | | | | | | | | | | | 1320.0560 (238) |

10a. Fuel costs - using BEDF prices (485)

| | | | |
|---------------------------------------|---------------|------------------|------------------|
| | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
| Space heating - main system 1 | 2026.6401 | 3.7400 | 75.7963 (240) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (242) |
| Water heating (other fuel) | 721.8480 | 3.7400 | 26.9971 (247) |
| Pumps and fans for heating | 75.0000 | 19.1200 | 14.3400 (249) |
| Pump for solar water heating | 50.0000 | 19.1200 | 9.5600 (249) |
| Energy for lighting | 270.1038 | 19.1200 | 51.6438 (250) |
| Additional standing charges | | | 94.0000 (251) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 19.1200 | -348.6600 (252) |
| Total energy cost | | | -76.3227 (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 | 2026.6401 | 0.2160 | 437.7543 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 721.8480 | 0.2160 | 155.9192 (264) |
| Space and water heating | | | 593.6734 (265) |
| Pumps and fans | 125.0000 | 0.5190 | 64.8750 (267) |
| Energy for lighting | 270.1038 | 0.5190 | 140.1839 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 0.5190 | -946.4151 (269) |
| Total kg/year | | | -147.6828 (272) |

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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 | 2026.6401 | 1.2200 | 2472.5009 (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 (263) |
| Water heating (other fuel) | 721.8480 | 1.2200 | 880.6545 (264) |
| Space and water heating | | | 3353.1554 (265) |
| Pumps and fans | 125.0000 | 3.0700 | 383.7500 (267) |
| Energy for lighting | 270.1038 | 3.0700 | 829.2187 (268) |
| Energy saving/generation technologies | | | |
| PV Unit | -1823.5358 | 3.0700 | -5598.2549 (269) |
| Primary energy kWh/year | | | -1032.1308 (272) |
| Primary energy kWh/m2/year | | | -18.0822 (273) |

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

Overheating Calculation Input Data

| | |
|---|--------------------------|
| Dwelling type | EndTerrace House |
| Number of storeys | 2 |
| Cross ventilation possible | Yes |
| SAP Region | Severn Valley |
| Front of dwelling faces | North West |
| Overshading | Average or unknown |
| Thermal mass parameter | 100.0 |
| Night ventilation | No |
| Ventilation rate during hot weather (ach) | 4.00 (Windows half open) |

Overheating Calculation

| | |
|--|-------------|
| Summer ventilation heat loss coefficient | 183.47 (P1) |
| Transmission heat loss coefficient | 43.92 (37) |
| Summer heat loss coefficient | 227.39 (P2) |

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

| Solar shading Orientation | Z blinds | Solar access | Z overhangs | Z summer |
|---------------------------|----------|--------------|-------------|------------|
| South East | 0.850 | 0.90 | 1.000 | 0.765 (P8) |
| North West | 0.850 | 0.90 | 1.000 | 0.765 (P8) |

| [Jul] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Shading | Gains W |
|------------|---------|--------------------------|-----------------------------|------------------------------|---------|----------|
| South East | 2.9400 | 121.5729 | 0.7100 | 0.7000 | 0.7650 | 122.3050 |
| South East | 3.2000 | 121.5729 | 0.7100 | 0.7000 | 0.7650 | 133.1211 |
| North West | 3.3100 | 100.3588 | 0.7100 | 0.7000 | 0.7650 | 113.6695 |

total: 369.0956

| | Jun | Jul | Aug |
|--|-----------------|--------|------------|
| Solar gains | 401 | 369 | 330 (P3) |
| Internal gains | 339 | 325 | 332 |
| Total summer gains | 740 | 694 | 662 (P5) |
| Summer gain/loss ratio | 3.25 | 3.05 | 2.91 (P6) |
| Summer external temperature | 15.00 | 16.70 | 16.70 |
| Thermal mass temperature increment (TMP = 100.0) | 1.30 | 1.30 | 1.30 |
| Threshold temperature | 19.55 | 21.05 | 20.91 (P7) |
| Likelihood of high internal temperature | Not significant | Slight | Slight |

Assessment of likelihood of high internal temperature: Slight