



## SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: 7 Haines Crescent, West End  
Southampton, SO30 3LG

Contact: Tobias Whiting  
Abacus Energy (UK) Ltd  
tobiaswhiting26@gmail.com

Report Issue Date: 22/03/2022

EXCELLENCE  
IN ENERGY  
ASSESSMENT

# BUILDING REGULATION COMPLIANCE

## Calculation Type: New Build (As Built)

|                                    |                                                                                          |                |             |
|------------------------------------|------------------------------------------------------------------------------------------|----------------|-------------|
| Property Reference                 | SAP 0647 Plot 80                                                                         | Issued on Date | 22/03/2022  |
| Assessment Reference               | As Built                                                                                 | Prop Type Ref  | D (HA/AR)   |
| Property                           | 7 Haines Crescent, West End, Southampton, SO30 3LG                                       |                |             |
| SAP Rating                         | 87 B                                                                                     | DER            | 14.28       |
| Environmental                      | 90 B                                                                                     | TER            | 19.26       |
| CO <sub>2</sub> Emissions (t/year) | 0.74                                                                                     | % DER<TER      | 25.84       |
| General Requirements Compliance    | Pass                                                                                     | DfEE           | 43.45       |
|                                    |                                                                                          | TfEE           | 53.61       |
|                                    |                                                                                          | % DfEE<TfEE    | 18.96       |
| Assessor Details                   | Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com |                | Assessor ID |
|                                    |                                                                                          |                | E477-0001   |
| Client                             | Foreman Homes, FORE                                                                      |                |             |

### SUMMARY FOR INPUT DATA FOR New Build (As Built)

#### 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)   | 19.26            | kgCO <sub>2</sub> /m <sup>2</sup> |      |
| Dwelling Carbon Dioxide Emission Rate (DER) | 14.28            | kgCO <sub>2</sub> /m <sup>2</sup> | Pass |
|                                             | -4.98 (-25.9%)   | kgCO <sub>2</sub> /m <sup>2</sup> |      |

##### 1b TfEE and DfEE

|                                          |                |                        |      |
|------------------------------------------|----------------|------------------------|------|
| Target Fabric Energy Efficiency (TfEE)   | 53.61          | kWh/m <sup>2</sup> /yr |      |
| Dwelling Fabric Energy Efficiency (DfEE) | 43.45          | kWh/m <sup>2</sup> /yr |      |
|                                          | -10.2 (-19.0%) | kWh/m <sup>2</sup> /yr | Pass |

#### Criterion 2 – Limits on design flexibility

##### Limiting Fabric Standards

##### 2 Fabric U-values

| Element       | Average          | Highest          |      |
|---------------|------------------|------------------|------|
| External wall | 0.24 (max. 0.30) | 0.24 (max. 0.70) | Pass |
| Party wall    | 0.00 (max. 0.20) | -                | Pass |
| Floor         | 0.12 (max. 0.25) | 0.12 (max. 0.70) | Pass |
| Roof          | 0.10 (max. 0.20) | 0.10 (max. 0.35) | Pass |
| Openings      | 1.19 (max. 2.00) | 1.20 (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 | 4.13 (measured in this dwelling) | m <sup>3</sup> /(h.m <sup>2</sup> ) @ 50 Pa |      |
| Maximum                        | 10.0                             | m <sup>3</sup> /(h.m <sup>2</sup> ) @ 50 Pa | Pass |

##### Limiting System Efficiencies

##### 4 Heating efficiency

This report has been produced by an accredited Elmhurst member whose work is subject to quality assurance audits. The data used to produce the report has been verified by the Elmhurst members' portal.

# BUILDING REGULATION COMPLIANCE

## Calculation Type: New Build (As Built)

Main heating system

Boiler system with radiators or underfloor - Mains gas  
Data from database  
Worcester Greenstar 30Si Compact ErP  
Combi boiler  
Efficiency: 89.8% SEDBUK2009  
Minimum: 88.0%

Pass

Secondary heating system

None

### 5 Cylinder insulation

Hot water storage

No cylinder

### 6 Controls

Space heating controls

Programmer, room thermostat and TRVs

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

Continuous extract system

Specific fan power

0.30

Maximum

0.7

Pass

## Criterion 3 – Limiting the effects of heat gains in summer

### 9 Summertime temperature

Overheating risk (Southern England)

Slight

Pass

Based on:

Overshading

Average

Windows facing North East

3.43 m<sup>2</sup>, No overhang

Windows facing South West

7.49 m<sup>2</sup>, No overhang

Windows facing North West

1.32 m<sup>2</sup>, No overhang

Air change rate

4.00 ach

Blinds/curtains

None

## Criterion 4 – Building performance consistent with DER and DFEE rate

### Party Walls

Type

U-value

Filled Cavity with Edge Sealing

0.00

W/m<sup>2</sup>K

Pass

### Air permeability and pressure testing

#### 3 Air permeability

Air permeability at 50 pascals

4.13 (measured in this dwelling) m<sup>3</sup>/(h.m<sup>2</sup>) @ 50 Pa

Maximum

10.0 m<sup>3</sup>/(h.m<sup>2</sup>) @ 50 Pa

Pass

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# BUILDING REGULATION COMPLIANCE

## Calculation Type: New Build (As Built)

### 10 Key features

|                                |       |                    |
|--------------------------------|-------|--------------------|
| Party wall U-value             | 0.00  | W/m <sup>2</sup> K |
| Roof U-value                   | 0.10  | W/m <sup>2</sup> K |
| Floor U-value                  | 0.12  | W/m <sup>2</sup> K |
| Door U-value                   | 1.10  | W/m <sup>2</sup> K |
| Thermal bridging $\psi$ -value | 0.039 | W/m <sup>2</sup> K |
| Photovoltaic array             | 0.64  | kW                 |

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# THERMAL BRIDGING

## Calculation Type: New Build (As Built)

|                      |                                                    |                |            |
|----------------------|----------------------------------------------------|----------------|------------|
| Property Reference   | SAP 0647 Plot 80                                   | Issued on Date | 22/03/2022 |
| Assessment Reference | As Built                                           | Prop Type Ref  | D (HA/AR)  |
| Property             | 7 Haines Crescent, West End, Southampton, SO30 3LG |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 87 B | DER         | 14.28 | TER  | 19.26 |
| Environmental                      | 90 B | % DER<TER   | 25.84 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.74 | DFEE        | 43.45 | TFEE | 53.61 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 18.96 |      |       |

|                  |                                                                                          |             |           |
|------------------|------------------------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com | Assessor ID | E477-0001 |
|------------------|------------------------------------------------------------------------------------------|-------------|-----------|

|        |                     |
|--------|---------------------|
| Client | Foreman Homes, FORE |
|--------|---------------------|

|               | Junction detail                                      | Source Type            | Psi (W/mK) | Length (m) | Result | Reference         |
|---------------|------------------------------------------------------|------------------------|------------|------------|--------|-------------------|
| External wall | E2 Other lintels (including other steel lintels)     | Independently assessed | 0.077      | 1.26       | 0.10   | Birtley Supatherm |
| External wall | E2 Other lintels (including other steel lintels)     | Independently assessed | 0.070      | 2.75       | 0.19   | Birtley Supatherm |
| External wall | E2 Other lintels (including other steel lintels)     | Independently assessed | 0.071      | 1.01       | 0.07   | Birtley Supatherm |
| External wall | E2 Other lintels (including other steel lintels)     | Independently assessed | 0.067      | 3.60       | 0.24   | Birtley Supatherm |
| External wall | E2 Other lintels (including other steel lintels)     | Independently assessed | 0.070      | 1.51       | 0.11   | Birtley Supatherm |
| External wall | E3 Sill                                              | Independently assessed | 0.021      | 7.61       | 0.16   | Knauf P5          |
| External wall | E4 Jamb                                              | Independently assessed | 0.016      | 27.30      | 0.44   | Knauf P6          |
| External wall | E5 Ground floor (normal)                             | Independently assessed | 0.060      | 16.79      | 1.01   | CBA - 302         |
| External wall | E6 Intermediate floor within a dwelling              | Independently assessed | 0.000      | 16.79      | 0.00   | CD0029            |
| External wall | E10 Eaves (insulation at ceiling level)              | Table K1 - Approved    | 0.060      | 16.79      | 1.01   |                   |
| External wall | E16 Corner (normal)                                  | Independently assessed | 0.039      | 10.10      | 0.39   | Knauf P23         |
| External wall | E18 Party wall between dwellings                     | Table K1 - Approved    | 0.060      | 10.10      | 0.61   |                   |
| Party wall    | P1 Party wall - Ground floor                         | Table K1 - Default     | 0.160      | 8.50       | 1.36   |                   |
| Party wall    | P2 Party wall - Intermediate floor within a dwelling | Table K1 - Default     | 0.000      | 8.50       | 0.00   |                   |
| Party wall    | P4 Party wall - Roof (insulation at ceiling level)   | Independently assessed | 0.049      | 8.50       | 0.42   | CD0020            |

Total: **6.10** W/mK:  
Y-Value: **0.039** W/m²K:

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

|                                    |                                                                                          |               |           |      |                |            |
|------------------------------------|------------------------------------------------------------------------------------------|---------------|-----------|------|----------------|------------|
| Property Reference                 | SAP 0647 Plot 80                                                                         |               |           |      | Issued on Date | 22/03/2022 |
| Assessment Reference               | As Built                                                                                 | Prop Type Ref | D (HA/AR) |      |                |            |
| Property                           | 7 Haines Crescent, West End, Southampton, SO30 3LG                                       |               |           |      |                |            |
|                                    |                                                                                          |               |           |      |                |            |
| SAP Rating                         | 87 B                                                                                     | DER           | 14.28     | TER  | 19.26          |            |
| Environmental                      | 90 B                                                                                     | % DER<TER     | 25.84     |      |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.74                                                                                     | DFEE          | 43.45     | TFEE | 53.61          |            |
| General Requirements Compliance    | Pass                                                                                     | % DFEE<TFEE   | 18.96     |      |                |            |
|                                    |                                                                                          |               |           |      |                |            |
| Assessor Details                   | Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com |               |           |      | Assessor ID    | E477-0001  |
| Client                             | Foreman Homes, FORE                                                                      |               |           |      |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

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

#### DWELLING AS BUILT

Semi-Detached House, total floor area 70 m<sup>2</sup>

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) 19.26 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 14.28 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.6 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)43.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.24 (max. 0.30) | 0.24 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.12 (max. 0.25) | 0.12 (max. 0.70) | OK |
| Roof          | 0.10 (max. 0.20) | 0.10 (max. 0.35) | OK |
| Openings      | 1.19 (max. 2.00) | 1.20 (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: 4.13 (measured in this dwelling)  
Maximum 10.0 OK

#### 4 Heating efficiency

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

Data from database

Worcester Greenstar 30Si Compact ErP

Combi boiler

Efficiency: 89.8% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

#### 7 Low energy lights

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

#### 8 Mechanical ventilation

Continuous extract system

Specific fan power: 0.30  
Maximum 0.7 OK

#### 9 Summertime temperature

Overheating risk (Southern England): Slight OK

Based on:

Overshading: Average

Windows facing North East: 3.43 m<sup>2</sup>, No overhang

Windows facing South West: 7.49 m<sup>2</sup>, No overhang

Windows facing North West: 1.32 m<sup>2</sup>, No overhang

Air change rate: 4.00 ach

Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K

Roof U-value 0.10 W/m<sup>2</sup>K

Floor U-value 0.12 W/m<sup>2</sup>K

Door U-value 1.10 W/m<sup>2</sup>K

Thermal bridging y-value 0.039 W/m<sup>2</sup>K

Photovoltaic array 0.64 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                      |        |        |        |        |        |        |        |        |        | main                         | secondary | other        | total | m3 per hour |                |            |             |     |     |     |     |
|------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------------------------|-----------|--------------|-------|-------------|----------------|------------|-------------|-----|-----|-----|-----|
|                                                      |        |        |        |        |        |        |        |        |        | heating                      | heating   |              |       |             |                |            |             |     |     |     |     |
| Number of chimneys                                   |        |        |        |        |        |        |        |        |        | 0                            | +         | 0            | +     | 0           | =              | 0 * 40 =   | 0.0000 (6a) |     |     |     |     |
| Number of open flues                                 |        |        |        |        |        |        |        |        |        | 0                            | +         | 0            | +     | 0           | =              | 0 * 20 =   | 0.0000 (6b) |     |     |     |     |
| Number of intermittent fans                          |        |        |        |        |        |        |        |        |        |                              |           |              |       |             |                | 0 * 10 =   | 0.0000 (7a) |     |     |     |     |
| Number of passive vents                              |        |        |        |        |        |        |        |        |        |                              |           |              |       |             |                | 0 * 10 =   | 0.0000 (7b) |     |     |     |     |
| Number of flueless gas fires                         |        |        |        |        |        |        |        |        |        |                              |           |              |       |             |                | 0 * 40 =   | 0.0000 (7c) |     |     |     |     |
| Infiltration due to chimneys, flues and fans         |        |        |        |        |        |        |        |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |           |              |       |             | 0.0000 / (5) = | 0.0000 (8) |             |     |     |     |     |
| Pressure test                                        |        |        |        |        |        |        |        |        |        |                              |           |              |       |             | Yes            |            |             |     |     |     |     |
| Measured/design AP50                                 |        |        |        |        |        |        |        |        |        |                              |           |              |       |             | 4.1300         |            |             |     |     |     |     |
| Infiltration rate                                    |        |        |        |        |        |        |        |        |        |                              |           |              |       |             | 0.2065 (18)    |            |             |     |     |     |     |
| Number of sides sheltered                            |        |        |        |        |        |        |        |        |        |                              |           |              |       |             | 1 (19)         |            |             |     |     |     |     |
| Shelter factor                                       |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] =  |           |              |       |             | 0.9250 (20)    |            |             |     |     |     |     |
| Infiltration rate adjusted to include shelter factor |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) =         |           |              |       |             | 0.1910 (21)    |            |             |     |     |     |     |
|                                                      |        |        |        |        |        |        |        |        |        | Jan                          | Feb       | Mar          | Apr   | May         | Jun            | Jul        | Aug         | Sep | Oct | Nov | Dec |
| Wind speed                                           | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000                       | 4.5000    | 4.7000 (22)  |       |             |                |            |             |     |     |     |     |
| Wind factor                                          | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750                       | 1.1250    | 1.1750 (22a) |       |             |                |            |             |     |     |     |     |
| Adj infilt rate                                      | 0.2435 | 0.2388 | 0.2340 | 0.2101 | 0.2053 | 0.1815 | 0.1815 | 0.1767 | 0.1910 | 0.2053                       | 0.2149    | 0.2244 (22b) |       |             |                |            |             |     |     |     |     |
| Mechanical extract ventilation - centralised         |        |        |        |        |        |        |        |        |        |                              |           |              |       |             |                |            |             |     |     |     |     |
| If mechanical ventilation:                           |        |        |        |        |        |        |        |        |        |                              |           |              |       |             | 0.5000 (23a)   |            |             |     |     |     |     |
| Effective ac                                         | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000                       | 0.5000    | 0.5000 (25)  |       |             |                |            |             |     |     |     |     |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Front Door                                                     |                         |                            | 2.1200                    | 1.1000                        | 2.3320       |                                      | (26)            |
| Windows (Uw = 1.20)                                            |                         |                            | 12.2400                   | 1.1450                        | 14.0153      |                                      | (27)            |
| Ground Floor                                                   |                         |                            | 35.1100                   | 0.1200                        | 4.2132       | 84.0000                              | 2949.2400 (28a) |
| Brick and Block                                                | 84.9600                 | 14.3600                    | 70.6000                   | 0.2400                        | 16.9440      | 42.2200                              | 2980.7320 (29a) |
| Pitched Roof                                                   | 35.1100                 |                            | 35.1100                   | 0.1000                        | 3.5110       | 9.1000                               | 319.5010 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 155.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 41.0155                       |              |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 42.9400                   | 0.0000                        | 0.0000       | 70.0000                              | 3005.8000 (32)  |
| GF Stud                                                        |                         |                            | 60.0000                   |                               |              | 9.0000                               | 540.0000 (32c)  |
| First Floor                                                    |                         |                            | 74.5300                   |                               |              | 9.0000                               | 670.7700 (32c)  |
| Internal Floor 1                                               |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 11730.0030 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 167.0465 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.0959 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 47.1114 (37)    |

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

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 (38) |
| Heat transfer coeff       | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 76.4247 (39) |
| HLP                       | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0884 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

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

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.2515 (42)  |
| Average daily hot water use (litres/day) | 87.6720 (43) |

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                                                 |          |          |          |          |          |          |          |          |          |                                           |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|----------------|
| Energy conte                                                    | 96.4392  | 92.9324  | 89.4255  | 85.9186  | 82.4117  | 78.9048  | 78.9048  | 82.4117  | 85.9186  | 89.4255                                   | 92.9324  | 96.4392 (44)   |
| Energy content (annual)                                         | 143.0166 | 125.0832 | 129.0747 | 112.5304 | 107.9756 | 93.1748  | 86.3401  | 99.0766  | 100.2598 | 116.8432                                  | 127.5435 | 138.5039 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m =                       |          | 1379.4225 (45) |
|                                                                 | 21.4525  | 18.7625  | 19.3612  | 16.8796  | 16.1963  | 13.9762  | 12.9510  | 14.8615  | 15.0390  | 17.5265                                   | 19.1315  | 20.7756 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                                           |          |                |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000 (57)    |
| Combi loss                                                      | 31.2121  | 28.1758  | 31.1694  | 30.1354  | 31.1192  | 30.0914  | 31.0795  | 31.1052  | 30.1154  | 31.1486                                   | 30.1769  | 31.2039 (61)   |
| Total heat required for water heating calculated for each month | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818 | 130.3752 | 147.9918                                  | 157.7204 | 169.7078 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818 | 130.3752 | 147.9918                                  | 157.7204 | 169.7078 (64)  |
| Heat gains from water heating, kWh/month                        | 55.3561  | 48.6341  | 50.7097  | 44.9502  | 43.6817  | 38.5035  | 36.4780  | 40.7193  | 40.8652  | 46.6375                                   | 49.9524  | 53.8535 (65)   |
|                                                                 |          |          |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          | 0.0000 (63)    |
|                                                                 |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          | 1746.1553 (64) |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 18.1079  | 16.0832  | 13.0798  | 9.9022   | 7.4020   | 6.2491   | 6.7524   | 8.7770   | 11.7805  | 14.9580  | 17.4582  | 18.6111 (67)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 197.8100 | 199.8626 | 194.6900 | 183.6782 | 169.7776 | 156.7131 | 147.9852 | 145.9326 | 151.1052 | 162.1171 | 176.0176 | 189.0821 (68) |
| Pumps, fans                                                                         | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 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)   |
| Water heating gains (Table 5)                                                       | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 (71) |
| Total internal gains                                                                | 74.4033  | 72.3722  | 68.1582  | 62.4309  | 58.7120  | 53.4770  | 49.0295  | 54.7302  | 56.7573  | 62.6848  | 69.3784  | 72.3838 (72)  |
|                                                                                     | 350.0930 | 348.0899 | 335.6998 | 315.7831 | 295.6634 | 276.2111 | 263.5390 | 269.2116 | 279.4147 | 299.5317 | 322.6260 | 339.8488 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| <hr/>       |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Northeast   |          |          |          | 3.4300     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 11.8274 (75) |          |          |               |
| Southwest   |          |          |          | 7.4900     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 84.2226 (79) |          |          |               |
| Northwest   |          |          |          | 1.3200     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 4.5516 (81)  |          |          |               |
| <hr/>       |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 100.6016 | 176.8022 | 256.3593 | 341.8634   | 405.0239                       | 411.8198                          | 392.9912                           | 344.3839                     | 285.7358     | 199.3004 | 121.4883 | 85.4529 (83)  |
| Total gains | 450.6946 | 524.8921 | 592.0591 | 657.6464   | 700.6874                       | 688.0309                          | 656.5302                           | 613.5954                     | 565.1505     | 498.8321 | 444.1143 | 425.3017 (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                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| alpha                                                                       | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345      |
| util living area                                                            | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423       |
| MIT                                                                         | 0.9881  | 0.9779  | 0.9560  | 0.9035  | 0.7991  | 0.6424  | 0.4923  | 0.5421  | 0.7651  | 0.9305  | 0.9793  | 0.9904 (86)  |
| Th 2                                                                        | 19.4701 | 19.6797 | 20.0019 | 20.3915 | 20.7223 | 20.9132 | 20.9760 | 20.9651 | 20.8253 | 20.3913 | 19.8450 | 19.4117 (87) |
| util rest of house                                                          | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 (88) |
| MIT 2                                                                       | 0.9854  | 0.9730  | 0.9460  | 0.8810  | 0.7528  | 0.5639  | 0.3900  | 0.4380  | 0.6968  | 0.9095  | 0.9739  | 0.9882 (89)  |
| Living area fraction                                                        | 18.6175 | 18.8246 | 19.1406 | 19.5138 | 19.8122 | 19.9634 | 20.0019 | 19.9971 | 19.9038 | 19.5215 | 18.9901 | 18.5596 (90) |
| MIT                                                                         | 18.8072 | 19.0148 | 19.3322 | 19.7090 | 20.0147 | 20.1747 | 20.2186 | 20.2124 | 20.1087 | 19.7150 | 19.1803 | 18.7491 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.8072 | 19.0148 | 19.3322 | 19.7090 | 20.0147 | 20.1747 | 20.2186 | 20.2124 | 20.1087 | 19.7150 | 19.1803 | 18.7491 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9811    | 0.9667    | 0.9376   | 0.8730   | 0.7530   | 0.5778   | 0.4123   | 0.4602   | 0.7043   | 0.9018       | 0.9679   | 0.9845 (94)    |
| Ext temp.            | 442.1674  | 507.4342  | 555.1006 | 574.1258 | 527.6480 | 397.5201 | 270.6865 | 282.3717 | 398.0620 | 449.8599     | 429.8509 | 418.6975 (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         | 1108.7067 | 1078.7210 | 980.6944 | 826.0754 | 635.4455 | 426.0450 | 276.5509 | 291.3646 | 459.2169 | 696.6122     | 923.2303 | 1111.9119 (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        | 495.9052  | 383.9048  | 316.6418 | 181.4038 | 80.2013  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 183.5837     | 355.2332 | 515.7515 (98)  |
| Space heating per m2 |           |           |          |          |          |          |          |          |          |              |          | 2512.6252 (98) |
|                      |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 35.7822 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

8c. Space cooling requirement

Not applicable

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

|                                                                       |                 |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 (201)    |          |          |          |          |          |          |          |          |          |          |                 |
| Fraction of space heat from main system(s)                            | 1.0000 (202)    |          |          |          |          |          |          |          |          |          |          |                 |
| Efficiency of main space heating system 1 (in %)                      | 90.7000 (206)   |          |          |          |          |          |          |          |          |          |          |                 |
| Efficiency of secondary/supplementary heating system, %               | 0.0000 (208)    |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating requirement                                             | 2770.2594 (211) |          |          |          |          |          |          |          |          |          |          |                 |
|                                                                       | Jan             | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 495.9052        | 383.9048 | 316.6418 | 181.4038 | 80.2013  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 183.5837 | 355.2332 | 515.7515 (98)   |
| Space heating efficiency (main heating system 1)                      | 90.7000         | 90.7000  | 90.7000  | 90.7000  | 90.7000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.7000  | 90.7000  | 90.7000 (210)   |
| Space heating fuel (main heating system)                              | 546.7533        | 423.2688 | 349.1090 | 200.0041 | 88.4248  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 202.4076 | 391.6573 | 568.6345 (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                                             | 174.2288        | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818 | 130.3752 | 147.9918 | 157.7204 | 169.7078 (64)   |
| Efficiency of water heater (217)m                                     | 89.7081         | 89.6126  | 89.4221  | 89.0331  | 88.3176  | 87.0000  | 87.0000  | 87.0000  | 87.0000  | 89.0104  | 89.5293  | 87.0000 (216)   |
| Fuel for water heating, kWh/month                                     | 194.2174        | 171.0239 | 179.1996 | 160.2392 | 157.4938 | 141.6852 | 134.9651 | 149.6342 | 149.8566 | 166.2634 | 176.1663 | 189.0791 (219)  |
| Water heating fuel used                                               |                 |          |          |          |          |          |          |          |          |          |          | 1969.8239 (219) |
| Annual totals kWh/year                                                |                 |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |                 |          |          |          |          |          |          |          |          |          |          | 2770.2594 (211) |
| Space heating fuel - secondary                                        |                 |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |                 |          |          |          |          |          |          |          |          |          |          |                 |
| (MEV)Centralised, Database: in-use factor = 1.4000, SFP = 0.4200)     |                 |          |          |          |          |          |          |          |          |          |          |                 |
| mechanical ventilation fans (SFP = 0.4200)                            |                 |          |          |          |          |          |          |          |          |          |          | 91.0312 (230a)  |
| central heating pump                                                  |                 |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |                 |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |                 |          |          |          |          |          |          |          |          |          |          | 166.0312 (231)  |
| Electricity for lighting (calculated in Appendix L)                   |                 |          |          |          |          |          |          |          |          |          |          | 319.7904 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |                 |          |          |          |          |          |          |          |          |          |          |                 |
| PV Unit 0 (0.80 + 0.64 + 1029 + 1.00) =                               |                 |          |          |          |          |          |          |          |          |          |          | -526.9436 (233) |
| Total delivered energy for all uses                                   |                 |          |          |          |          |          |          |          |          |          |          | 4698.9613 (238) |

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

|                                             | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1               | 2770.2594          | 0.2160                        | 598.3760 (261)           |
| Space heating - secondary                   | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                  | 1969.8239          | 0.2160                        | 425.4820 (264)           |
| Space and water heating                     |                    |                               | 1023.8580 (265)          |
| Pumps and fans                              | 166.0312           | 0.5190                        | 86.1702 (267)            |
| Energy for lighting                         | 319.7904           | 0.5190                        | 165.9712 (268)           |
| Energy saving/generation technologies       |                    |                               |                          |
| PV Unit                                     | -526.9436          | 0.5190                        | -273.4837 (269)          |
| Total CO2, kg/year                          |                    |                               | 1002.5157 (272)          |
| Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 14.2800 (273)            |

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

|                                                                                 |         |     |
|---------------------------------------------------------------------------------|---------|-----|
| DER                                                                             | 14.2800 | ZC1 |
| Total Floor Area                                                                | 70.2200 |     |
| Assumed number of occupants                                                     | 2.2515  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   | 16.6930 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.4642  | ZC3 |
| Total CO2 emissions                                                             | 33.4372 | 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                                                               | 33.4372 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                                         | main<br>heating | secondary<br>heating | other | total                       | m3 per hour                |
|-------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                      | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                    | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                             |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                 |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                            |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) |                 |                      |       |                             | 30.0000 / (5) = 0.1689 (8) |
| Pressure test                                                           |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                    |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                       |                 |                      |       |                             | 0.4189 (18)                |
| Number of sides sheltered                                               |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                          |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                    |                 |                      |       | (21) = (18) x (20) =        | 0.3875 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4940 | 0.4843 | 0.4746 | 0.4262 | 0.4165 | 0.3681 | 0.3681 | 0.3584 | 0.3875 | 0.4165 | 0.4359 | 0.4553 (22b) |
| Effective ac    | 0.6220 | 0.6173 | 0.6126 | 0.5908 | 0.5867 | 0.5677 | 0.5677 | 0.5642 | 0.5751 | 0.5867 | 0.5950 | 0.6036 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K     | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| TER Opaque door                                                     |                |                | 2.1200         | 1.0000               | 2.1200         |                   | (26)           |                |                |                |                |                     |
| TER Opening Type (Uw = 1.40)                                        |                |                | 12.2400        | 1.3258               | 16.2273        |                   | (27)           |                |                |                |                |                     |
| Ground Floor                                                        |                |                | 35.1100        | 0.1300               | 4.5643         |                   | (28a)          |                |                |                |                |                     |
| Brick and Block                                                     | 84.9600        | 14.3600        | 70.6000        | 0.1800               | 12.7080        |                   | (29a)          |                |                |                |                |                     |
| Pitched Roof                                                        | 35.1100        |                | 35.1100        | 0.1300               | 4.5643         |                   | (30)           |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 155.1800       |                      |                |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)...(30) + (32) = | 40.1839        |                   | (33)           |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                      |                |                   | 250.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                      |                |                   | 9.1608 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                |                      |                | (33) + (36) =     | 49.3447 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                      |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>36.4668 | Feb<br>36.1890 | Mar<br>35.9168 | Apr<br>34.6379       | May<br>34.3986 | Jun<br>33.2847    | Jul<br>33.2847 | Aug<br>33.0785 | Sep<br>33.7138 | Oct<br>34.3986 | Nov<br>34.8827 | Dec<br>35.3887 (38) |
| Heat transfer coeff                                                 | 85.8115        | 85.5337        | 85.2614        | 83.9826              | 83.7433        | 82.6294           | 82.6294        | 82.4231        | 83.0585        | 83.7433        | 84.2273        | 84.7334 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                      |                |                   |                |                |                |                |                | 83.9814 (39)        |
| HLP                                                                 | Jan<br>1.2220  | Feb<br>1.2181  | Mar<br>1.2142  | Apr<br>1.1960        | May<br>1.1926  | Jun<br>1.1767     | Jul<br>1.1767  | Aug<br>1.1738  | Sep<br>1.1828  | Oct<br>1.1926  | Nov<br>1.1995  | Dec<br>1.2067 (40)  |
| HLP (average)                                                       |                |                |                |                      |                |                   |                |                |                |                |                | 1.1960 (40)         |
| Days in month                                                       | 31             | 28             | 31             | 30                   | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

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

|                                              |                      |          |          |          |          |         |         |         |          |          |                    |                |
|----------------------------------------------|----------------------|----------|----------|----------|----------|---------|---------|---------|----------|----------|--------------------|----------------|
| Assumed occupancy                            |                      |          |          |          |          |         |         |         |          |          |                    | 2.2515 (42)    |
| Average daily hot water use (litres/day)     |                      |          |          |          |          |         |         |         |          |          |                    | 87.6720 (43)   |
|                                              | Jan                  | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep      | Oct      | Nov                | Dec            |
| Daily hot water use                          | 96.4392              | 92.9324  | 89.4255  | 85.9186  | 82.4117  | 78.9048 | 78.9048 | 82.4117 | 85.9186  | 89.4255  | 92.9324            | 96.4392 (44)   |
| Energy conte                                 | 143.0166             | 125.0832 | 129.0747 | 112.5304 | 107.9756 | 93.1748 | 86.3401 | 99.0766 | 100.2598 | 116.8432 | 127.5435           | 138.5039 (45)  |
| Energy content (annual)                      |                      |          |          |          |          |         |         |         |          |          | Total = Sum(45)m = | 1379.4225 (45) |
| Distribution loss                            | (46)m = 0.15 x (45)m |          |          |          |          |         |         |         |          |          |                    |                |
|                                              | 21.4525              | 18.7625  | 19.3612  | 16.8796  | 16.1963  | 13.9762 | 12.9510 | 14.8615 | 15.0390  | 17.5265  | 19.1315            | 20.7756 (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 Built)

### 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 (57)   |
| Total heat required for water heating calculated for each month | 49.1444  | 42.7743  | 45.5702  | 42.3708  | 41.9961  | 38.9120  | 40.2090  | 41.9961  | 42.3708  | 45.5702  | 45.8297  | 49.1444 (61)  |
| Solar input                                                     | 192.1610 | 167.8576 | 174.6449 | 154.9013 | 149.9718 | 132.0867 | 126.5492 | 141.0727 | 142.6307 | 162.4134 | 173.3731 | 187.6483 (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                        | 192.1610 | 167.8576 | 174.6449 | 154.9013 | 149.9718 | 132.0867 | 126.5492 | 141.0727 | 142.6307 | 162.4134 | 173.3731 | 187.6483 (64) |
|                                                                 | 59.8391  | 52.2838  | 54.3099  | 48.0091  | 46.4009  | 40.7086  | 38.7604  | 43.4420  | 43.9291  | 50.2429  | 53.8656  | 58.3387 (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                                                                               | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.1079  | 16.0832  | 13.0798  | 9.9022   | 7.4020   | 6.2491   | 6.7524   | 8.7770   | 11.7805  | 14.9580  | 17.4582  | 18.6111  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 197.8100 | 199.8626 | 194.6900 | 183.6782 | 169.7776 | 156.7131 | 147.9852 | 145.9326 | 151.1052 | 162.1171 | 176.0176 | 189.0821 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | (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)                                 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | (71) |
| Water heating gains (Table 5)                                                       | 80.4289  | 77.8032  | 72.9972  | 66.6793  | 62.3668  | 56.5397  | 52.0972  | 58.3898  | 61.0126  | 67.5308  | 74.8134  | 78.4122  | (72) |
| Total internal gains                                                                | 356.1186 | 353.5209 | 340.5388 | 320.0315 | 299.3183 | 279.2738 | 266.6067 | 272.8711 | 283.6701 | 304.3777 | 328.0609 | 345.8772 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Northeast   |          |          |          |          | 3.4300     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 11.8274 (75) |               |
| Southwest   |          |          |          |          | 7.4900     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 84.2226 (79) |               |
| Northwest   |          |          |          |          | 1.3200     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 4.5516 (81)  |               |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 100.6016 | 176.8022 | 256.3593 | 341.8634 | 405.0239   | 411.8198                       | 392.9912                          | 344.3839                           | 285.7358                     | 199.3004 | 121.4883     | 85.4529 (83)  |
| Total gains | 456.7202 | 530.3231 | 596.8981 | 661.8948 | 704.3423   | 691.0936                       | 659.5979                          | 617.2550                           | 569.4059                     | 503.6781 | 449.5493     | 431.3301 (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                                                                         | 56.8268 | 57.0113 | 57.1934 | 58.0643 | 58.2302 | 59.0152 | 59.0152 | 59.1629 | 58.7103 | 58.2302 | 57.8956 | 57.5498 |              |
| alpha                                                                       | 4.7885  | 4.8008  | 4.8129  | 4.8710  | 4.8820  | 4.9343  | 4.9343  | 4.9442  | 4.9140  | 4.8820  | 4.8597  | 4.8367  |              |
| util living area                                                            | 0.9971  | 0.9937  | 0.9842  | 0.9530  | 0.8688  | 0.7049  | 0.5377  | 0.5917  | 0.8336  | 0.9697  | 0.9941  | 0.9978  | (86)         |
| MIT                                                                         | 19.7094 | 19.8769 | 20.1423 | 20.4888 | 20.7786 | 20.9445 | 20.9882 | 20.9815 | 20.8691 | 20.4923 | 20.0405 | 19.6853 | (87)         |
| Th 2                                                                        | 19.9024 | 19.9056 | 19.9087 | 19.9232 | 19.9259 | 19.9387 | 19.9387 | 19.9410 | 19.9338 | 19.9259 | 19.9204 | 19.9147 | (88)         |
| util rest of house                                                          | 0.9962  | 0.9915  | 0.9786  | 0.9354  | 0.8206  | 0.6112  | 0.4149  | 0.4666  | 0.7577  | 0.9549  | 0.9917  | 0.9971  | (89)         |
| MIT 2                                                                       | 18.1934 | 18.4396 | 18.8260 | 19.3275 | 19.7105 | 19.9022 | 19.9344 | 19.9335 | 19.8303 | 19.3427 | 18.6895 | 18.1668 | (90)         |
| Living area fraction                                                        | 18.5306 | 18.7593 | 19.1188 | 19.5859 | 19.9480 | 20.1340 | 20.1688 | 20.1667 | 20.0614 | 19.5984 | 18.9901 | 18.5046 | (91)         |
| MIT                                                                         | 18.5306 | 18.7593 | 19.1188 | 19.5859 | 19.9480 | 20.1340 | 20.1688 | 20.1667 | 20.0614 | 19.5984 | 18.9901 | 18.5046 | (92)         |
| Temperature adjustment                                                      | 18.5306 | 18.7593 | 19.1188 | 19.5859 | 19.9480 | 20.1340 | 20.1688 | 20.1667 | 20.0614 | 19.5984 | 18.9901 | 18.5046 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 454.1353  | 524.1001  | 580.7783  | 614.5333 | 578.8168 | 435.2125 | 291.7921 | 305.2099 | 437.3610 | 477.9013 | 444.4499  | 429.4485  | (94)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W     | 1221.1494 | 1185.4377 | 1075.8987 | 897.4253 | 690.7186 | 457.2752 | 294.8884 | 310.4593 | 495.1427 | 753.5585 | 1001.4679 | 1212.0758 | (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    | 570.6585  | 444.4188  | 368.3695  | 203.6822 | 83.2549  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 205.0890 | 401.0529  | 582.2747  | (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |          |           | 2858.8006 | (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |           | 40.7121   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET EMISSIONS 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 %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.4000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 3060.8144 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 570.6585 | 444.4188 | 368.3695 | 203.6822 | 83.2549  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 205.0890 | 401.0529 | 582.2747 (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)                              | 610.9834 | 475.8232 | 394.3999 | 218.0752 | 89.1380  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 219.5813 | 429.3929 | 623.4204 (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                                             | 192.1610 | 167.8576 | 174.6449 | 154.9013 | 149.9718 | 132.0867 | 126.5492 | 141.0727 | 142.6307 | 162.4134 | 173.3731 | 187.6483 (64)   |
| Efficiency of water heater (217)m                                     | 87.6237  | 87.3867  | 86.8852  | 85.7413  | 83.6356  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 85.6396  | 87.0937  | 80.3000 (216)   |
| Fuel for water heating, kWh/month                                     | 219.3026 | 192.0860 | 201.0065 | 180.6611 | 179.3157 | 164.4916 | 157.5955 | 175.6820 | 177.6222 | 189.6475 | 199.0650 | 213.9388 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2250.4145 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3060.8144 (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)                   |          |          |          |          |          |          |          |          |          |          |          | 319.7904 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5706.0193 (238) |

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

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3060.8144          | 0.2160                        | 661.1359 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2250.4145          | 0.2160                        | 486.0895 (264)           |
| Space and water heating                                                                           |                    |                               | 1147.2254 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 319.7904           | 0.5190                        | 165.9712 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1352.1217 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.3376 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3636 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5543 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.3376 * 1.00) + 2.3636 + 0.5543, rounded to 2 d.p. |                    |                               | 19.2600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                                         | main<br>heating | secondary<br>heating | other                     | total | m3 per hour                |
|-------------------------------------------------------------------------|-----------------|----------------------|---------------------------|-------|----------------------------|
| Number of chimneys                                                      | 0               | +                    | 0                         | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                    | 0               | +                    | 0                         | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                             |                 |                      |                           |       | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                 |                 |                      |                           |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                            |                 |                      |                           |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) |                 |                      |                           |       | 30.0000 / (5) = 0.1689 (8) |
| Pressure test                                                           |                 |                      |                           |       | Yes                        |
| Measured/design AP50                                                    |                 |                      |                           |       | 4.1300                     |
| Infiltration rate                                                       |                 |                      |                           |       | 0.3754 (18)                |
| Number of sides sheltered                                               |                 |                      |                           |       | 1 (19)                     |
| Shelter factor                                                          |                 |                      | (20) = 1 - [0.075 x (19)] | =     | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                    |                 |                      | (21) = (18) x (20)        | =     | 0.3472 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4427 | 0.4340 | 0.4253 | 0.3819 | 0.3733 | 0.3299 | 0.3299 | 0.3212 | 0.3472 | 0.3733 | 0.3906 | 0.4080 (22b) |
| Effective ac    | 0.5980 | 0.5942 | 0.5905 | 0.5729 | 0.5697 | 0.5544 | 0.5544 | 0.5516 | 0.5603 | 0.5697 | 0.5763 | 0.5832 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|-----------------|
| Front Door                                                  |                         |                            | 2.1200                    | 1.1000                        | 2.3320       |                                | (26)            |
| Windows (Uw = 1.20)                                         |                         |                            | 12.2400                   | 1.1450                        | 14.0153      |                                | (27)            |
| Ground Floor                                                |                         |                            | 35.1100                   | 0.1200                        | 4.2132       | 84.0000                        | 2949.2400 (28a) |
| Brick and Block                                             | 84.9600                 | 14.3600                    | 70.6000                   | 0.2400                        | 16.9440      | 42.2200                        | 2980.7320 (29a) |
| Pitched Roof                                                | 35.1100                 |                            | 35.1100                   | 0.1000                        | 3.5110       | 9.1000                         | 319.5010 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 155.1800                  |                               |              |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 41.0155      |                                | (33)            |
| Party Wall 1                                                |                         |                            | 42.9400                   | 0.0000                        | 0.0000       | 70.0000                        | 3005.8000 (32)  |
| GF Stud                                                     |                         |                            | 60.0000                   |                               |              | 9.0000                         | 540.0000 (32c)  |
| First Floor                                                 |                         |                            | 74.5300                   |                               |              | 9.0000                         | 670.7700 (32c)  |
| Internal Floor 1                                            |                         |                            | 35.1100                   |                               |              | 18.0000                        | 631.9800 (32d)  |
| Internal Ceiling 1                                          |                         |                            | 35.1100                   |                               |              | 9.0000                         | 315.9900 (32e)  |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 11414.0130 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 162.5465 (35)  
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.0959 (36)  
Total fabric heat loss (33) + (36) = 47.1114 (37)

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

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 35.0582 | 34.8351 | 34.6164 | 33.5894 | 33.3972 | 32.5027 | 32.5027 | 32.3370 | 32.8473 | 33.3972 | 33.7860 | 34.1924 (38) |
| Heat transfer coeff       | 82.1696 | 81.9465 | 81.7278 | 80.7008 | 80.5086 | 79.6141 | 79.6141 | 79.4485 | 79.9587 | 80.5086 | 80.8974 | 81.3038 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 80.6999 (39) |
| HLP                       | 1.1702  | 1.1670  | 1.1639  | 1.1493  | 1.1465  | 1.1338  | 1.1338  | 1.1314  | 1.1387  | 1.1465  | 1.1521  | 1.1578 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.1492 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

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

|                                          |          |          |          |          |          |         |         |         |          |                    |          |                |
|------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|----------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |          |          |         |         |         |          |                    |          | 2.2515 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |         |         |         |          |                    |          | 87.6720 (43)   |
| Daily hot water use                      | 96.4392  | 92.9324  | 89.4255  | 85.9186  | 82.4117  | 78.9048 | 78.9048 | 82.4117 | 85.9186  | 89.4255            | 92.9324  | 96.4392 (44)   |
| Energy conte                             | 143.0166 | 125.0832 | 129.0747 | 112.5304 | 107.9756 | 93.1748 | 86.3401 | 99.0766 | 100.2598 | 116.8432           | 127.5435 | 138.5039 (45)  |
| Energy content (annual)                  |          |          |          |          |          |         |         |         |          | Total = Sum(45)m = |          | 1379.4225 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                              |         |         |         |         |         |         |         |         |         |         |         |              |
|----------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Distribution loss (46)m = 0.15 x (45)m       | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (46)  |
| Water storage loss:                          |         |         |         |         |         |         |         |         |         |         |         |              |
| Total storage loss                           | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (56)  |
| If cylinder contains dedicated solar storage | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (57)  |
| Primary loss                                 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (59)  |
| Heat gains from water heating, kWh/month     | 30.3910 | 26.5802 | 27.4284 | 23.9127 | 22.9448 | 19.7996 | 18.3473 | 21.0538 | 21.3052 | 24.8292 | 27.1030 | 29.4321 (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                                                                               | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | 112.5727 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.1079  | 16.0832  | 13.0798  | 9.9022   | 7.4020   | 6.2491   | 6.7524   | 8.7770   | 11.7805  | 14.9580  | 17.4582  | 18.6111  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 197.8100 | 199.8626 | 194.6900 | 183.6782 | 169.7776 | 156.7131 | 147.9852 | 145.9326 | 151.1052 | 162.1171 | 176.0176 | 189.0821 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | 34.2573  | (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)                                 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | (71) |
| Water heating gains (Table 5)                                                       | 40.8482  | 39.5539  | 36.8661  | 33.2121  | 30.8398  | 27.4995  | 24.6603  | 28.2981  | 29.5906  | 33.3725  | 37.6430  | 39.5593  | (72) |
| Total internal gains                                                                | 313.5378 | 312.2715 | 301.4077 | 283.5643 | 264.7913 | 247.2335 | 236.1697 | 239.7795 | 249.2480 | 267.2194 | 287.8906 | 304.0243 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |              | Gains<br>W |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|------------|---------------|
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |              |            |               |
| Northeast   |          |          |          |          | 3.4300     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 11.8274 (75) |            |               |
| Southwest   |          |          |          |          | 7.4900     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 84.2226 (79) |            |               |
| Northwest   |          |          |          |          | 1.3200     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 4.5516 (81)  |            |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |              |            |               |
| Solar gains | 100.6016 | 176.8022 | 256.3593 | 341.8634 | 405.0239   | 411.8198                       | 392.9912                          | 344.3839                           | 285.7358                     | 199.3004     | 121.4883   | 85.4529 (83)  |
| Total gains | 414.1394 | 489.0738 | 557.7670 | 625.4277 | 669.8153   | 659.0534                       | 629.1610                          | 584.1633                           | 534.9838                     | 466.5199     | 409.3789   | 389.4772 (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                                                                         | 38.5856 | 38.6906 | 38.7941 | 39.2878 | 39.3816 | 39.8241 | 39.8241 | 39.9071 | 39.6525 | 39.3816 | 39.1924 | 38.9965 |              |
| alpha                                                                       | 3.5724  | 3.5794  | 3.5863  | 3.6192  | 3.6254  | 3.6549  | 3.6549  | 3.6605  | 3.6435  | 3.6254  | 3.6128  | 3.5998  |              |
| util living area                                                            | 0.9903  | 0.9818  | 0.9634  | 0.9178  | 0.8252  | 0.6750  | 0.5257  | 0.5782  | 0.7966  | 0.9431  | 0.9833  | 0.9922  | (86)         |
| MIT                                                                         | 19.2303 | 19.4552 | 19.8067 | 20.2558 | 20.6373 | 20.8800 | 20.9637 | 20.9486 | 20.7672 | 20.2648 | 19.6661 | 19.1928 | (87)         |
| Th 2                                                                        | 19.9439 | 19.9465 | 19.9490 | 19.9608 | 19.9630 | 19.9733 | 19.9733 | 19.9733 | 19.9694 | 19.9630 | 19.9585 | 19.9539 | (88)         |
| util rest of house                                                          | 0.9881  | 0.9776  | 0.9547  | 0.8976  | 0.7811  | 0.5949  | 0.4158  | 0.4678  | 0.7306  | 0.9249  | 0.9788  | 0.9904  | (89)         |
| MIT 2                                                                       | 18.3322 | 18.5569 | 18.9051 | 19.3483 | 19.7002 | 19.9071 | 19.9604 | 19.9552 | 19.8239 | 19.3666 | 18.7769 | 18.3023 | (90)         |
| Living area fraction                                                        | 18.5320 | 18.7567 | 19.1057 | 19.5502 | 19.9087 | 20.1235 | 20.1836 | 20.1762 | 20.0337 | 19.5664 | 18.9747 | 18.5004 | (91)         |
| MIT                                                                         | 18.5320 | 18.7567 | 19.1057 | 19.5502 | 19.9087 | 20.1235 | 20.1836 | 20.1762 | 20.0337 | 19.5664 | 18.9747 | 18.5004 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.5320 | 18.7567 | 19.1057 | 19.5502 | 19.9087 | 20.1235 | 20.1836 | 20.1762 | 20.0337 | 19.5664 | 18.9747 | 18.5004 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |          |           |      |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |      |
| Useful gains         | 407.5242  | 475.1234  | 527.6329  | 555.4002 | 521.4532 | 400.4156 | 276.4162 | 286.6841 | 393.3576 | 427.4307 | 398.3840 | 384.3915  | (94) |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96) |
| Heat loss rate W     | 1169.4359 | 1135.5111 | 1030.2345 | 859.4798 | 660.8674 | 439.7466 | 285.3018 | 300.0109 | 474.4538 | 721.8756 | 960.6317 | 1162.6775 | (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (98) |
| Space heating kWh    | 566.8623  | 443.7806  | 373.9356  | 218.9373 | 103.7241 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 219.0670 | 404.8183 | 579.0448  | (98) |
| Space heating        |           |           |           |          |          |          |          |          |          |          |          | 2910.1701 | (98) |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |          | 41.4436   | (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  | 748.3726 | 589.1444 | 603.8083 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (100) |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.8338   | 0.8922   | 0.8679   | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (101) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |        |        |        |        |        |          |          |          |                          |        |        |                |
|------------------------------------------|--------|--------|--------|--------|--------|----------|----------|----------|--------------------------|--------|--------|----------------|
| Useful loss                              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 623.9922 | 525.6237 | 524.0298 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (102)   |
| Total gains                              | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 854.1596 | 817.5444 | 766.3662 | 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 | 165.7205 | 217.1890 | 180.2983 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (104)   |
| Space cooling                            |        |        |        |        |        |          |          |          |                          |        |        | 563.2078 (104) |
| Cooled fraction                          |        |        |        |        |        |          |          |          | FC = cooled area / (4) = |        |        | 1.0000 (105)   |
| Intermittency factor (Table 10b)         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500   | 0.2500   | 0.2500   | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (106)   |
| Space cooling kWh                        | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.4301  | 54.2973  | 45.0746  | 0.0000                   | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling                            |        |        |        |        |        |          |          |          |                          |        |        | 140.8020 (107) |
| Space cooling per m2                     |        |        |        |        |        |          |          |          |                          |        |        | 2.0052 (108)   |
| Energy for space heating                 |        |        |        |        |        |          |          |          |                          |        |        | 41.4436 (99)   |
| Energy for space cooling                 |        |        |        |        |        |          |          |          |                          |        |        | 2.0052 (108)   |
| Total                                    |        |        |        |        |        |          |          |          |                          |        |        | 43.4488 (109)  |
| Dwelling Fabric Energy Efficiency (DFEE) |        |        |        |        |        |          |          |          |                          |        |        | 43.4 (109)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                      |        |        |        |        |        |        |        |        |        | main                         | secondary | other  | total | m3 per hour |             |          |              |
|------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------------------------|-----------|--------|-------|-------------|-------------|----------|--------------|
|                                                      |        |        |        |        |        |        |        |        |        | heating                      | heating   |        |       |             |             |          |              |
| Number of chimneys                                   |        |        |        |        |        |        |        |        |        | 0                            | +         | 0      | +     | 0           | =           | 0 * 40 = | 0.0000 (6a)  |
| Number of open flues                                 |        |        |        |        |        |        |        |        |        | 0                            | +         | 0      | +     | 0           | =           | 0 * 20 = | 0.0000 (6b)  |
| Number of intermittent fans                          |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |             | 3 * 10 = | 30.0000 (7a) |
| Number of passive vents                              |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |             | 0 * 10 = | 0.0000 (7b)  |
| Number of flueless gas fires                         |        |        |        |        |        |        |        |        |        |                              |           |        |       |             |             | 0 * 40 = | 0.0000 (7c)  |
|                                                      |        |        |        |        |        |        |        |        |        | Air changes per hour         |           |        |       |             |             |          |              |
| Infiltration due to chimneys, flues and fans         |        |        |        |        |        |        |        |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |           |        |       |             | 30.0000     | / (5) =  | 0.1689 (8)   |
| Pressure test                                        |        |        |        |        |        |        |        |        |        | Yes                          |           |        |       |             |             |          |              |
| Measured/design AP50                                 |        |        |        |        |        |        |        |        |        | 5.0000                       |           |        |       |             |             |          |              |
| Infiltration rate                                    |        |        |        |        |        |        |        |        |        | 0.4189 (18)                  |           |        |       |             |             |          |              |
| Number of sides sheltered                            |        |        |        |        |        |        |        |        |        | 1 (19)                       |           |        |       |             |             |          |              |
| Shelter factor                                       |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] =  |           |        |       |             | 0.9250 (20) |          |              |
| Infiltration rate adjusted to include shelter factor |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) =         |           |        |       |             | 0.3875 (21) |          |              |
|                                                      | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct                          | Nov       | Dec    |       |             |             |          |              |
| Wind speed                                           | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000                       | 4.5000    | 4.7000 | (22)  |             |             |          |              |
| Wind factor                                          | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750                       | 1.1250    | 1.1750 | (22a) |             |             |          |              |
| Adj infilt rate                                      | 0.4940 | 0.4843 | 0.4746 | 0.4262 | 0.4165 | 0.3681 | 0.3681 | 0.3584 | 0.3875 | 0.4165                       | 0.4359    | 0.4553 | (22b) |             |             |          |              |
| Effective ac                                         | 0.6220 | 0.6173 | 0.6126 | 0.5908 | 0.5867 | 0.5677 | 0.5677 | 0.5642 | 0.5751 | 0.5867                       | 0.5950    | 0.6036 | (25)  |             |             |          |              |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K     | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| TER Opaque door                                                     |                |                | 2.1200         | 1.0000               | 2.1200         |                   | (26)           |                |                |                |                |                     |
| TER Opening Type (Uw = 1.40)                                        |                |                | 12.2400        | 1.3258               | 16.2273        |                   | (27)           |                |                |                |                |                     |
| Ground Floor                                                        |                |                | 35.1100        | 0.1300               | 4.5643         |                   | (28a)          |                |                |                |                |                     |
| Brick and Block                                                     | 84.9600        | 14.3600        | 70.6000        | 0.1800               | 12.7080        |                   | (29a)          |                |                |                |                |                     |
| Pitched Roof                                                        | 35.1100        |                | 35.1100        | 0.1300               | 4.5643         |                   | (30)           |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 155.1800       |                      |                |                   | (31)           |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)...(30) + (32) = | 40.1839        |                   | (33)           |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                      |                |                   | 250.0000 (35)  |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                      |                |                   | 9.1608 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                |                      |                | (33) + (36) =     | 49.3447 (37)   |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                      |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>36.4668 | Feb<br>36.1890 | Mar<br>35.9168 | Apr<br>34.6379       | May<br>34.3986 | Jun<br>33.2847    | Jul<br>33.2847 | Aug<br>33.0785 | Sep<br>33.7138 | Oct<br>34.3986 | Nov<br>34.8827 | Dec<br>35.3887 (38) |
| Heat transfer coeff                                                 | 85.8115        | 85.5337        | 85.2614        | 83.9826              | 83.7433        | 82.6294           | 82.6294        | 82.4231        | 83.0585        | 83.7433        | 84.2273        | 84.7334 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                      |                |                   |                |                |                |                |                | 83.9814 (39)        |
| HLP                                                                 | Jan<br>1.2220  | Feb<br>1.2181  | Mar<br>1.2142  | Apr<br>1.1960        | May<br>1.1926  | Jun<br>1.1767     | Jul<br>1.1767  | Aug<br>1.1738  | Sep<br>1.1828  | Oct<br>1.1926  | Nov<br>1.1995  | Dec<br>1.2067 (40)  |
| HLP (average)                                                       |                |                |                |                      |                |                   |                |                |                |                |                | 1.1960 (40)         |
| Days in month                                                       | 31             | 28             | 31             | 30                   | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

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

|                                              |                      |          |          |          |          |         |         |         |          |          |                    |                |
|----------------------------------------------|----------------------|----------|----------|----------|----------|---------|---------|---------|----------|----------|--------------------|----------------|
| Assumed occupancy                            |                      |          |          |          |          |         |         |         |          |          |                    | 2.2515 (42)    |
| Average daily hot water use (litres/day)     |                      |          |          |          |          |         |         |         |          |          |                    | 87.6720 (43)   |
|                                              | Jan                  | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep      | Oct      | Nov                | Dec            |
| Daily hot water use                          | 96.4392              | 92.9324  | 89.4255  | 85.9186  | 82.4117  | 78.9048 | 78.9048 | 82.4117 | 85.9186  | 89.4255  | 92.9324            | 96.4392 (44)   |
| Energy conte                                 | 143.0166             | 125.0832 | 129.0747 | 112.5304 | 107.9756 | 93.1748 | 86.3401 | 99.0766 | 100.2598 | 116.8432 | 127.5435           | 138.5039 (45)  |
| Energy content (annual)                      |                      |          |          |          |          |         |         |         |          |          | Total = Sum(45)m = | 1379.4225 (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 Built)

### 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 (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 (59)    |
|                                                                                     | 30.3910   | 26.5802   | 27.4284   | 23.9127    | 22.9448  | 19.7996       | 18.3473       | 21.0538  | 21.3052                   | 24.8292      | 27.1030      | 29.4321 (65)   |
| -----                                                                               |           |           |           |            |          |               |               |          |                           |              |              |                |
| 5. Internal gains (see Table 5 and 5a)                                              |           |           |           |            |          |               |               |          |                           |              |              |                |
| -----                                                                               |           |           |           |            |          |               |               |          |                           |              |              |                |
| Metabolic gains (Table 5), Watts                                                    |           |           |           |            |          |               |               |          |                           |              |              |                |
| (66)m                                                                               | Jan       | Feb       | Mar       | Apr        | May      | Jun           | Jul           | Aug      | Sep                       | Oct          | Nov          | Dec            |
|                                                                                     | 112.5727  | 112.5727  | 112.5727  | 112.5727   | 112.5727 | 112.5727      | 112.5727      | 112.5727 | 112.5727                  | 112.5727     | 112.5727     | 112.5727 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |            |          |               |               |          |                           |              |              |                |
|                                                                                     | 18.1079   | 16.0832   | 13.0798   | 9.9022     | 7.4020   | 6.2491        | 6.7524        | 8.7770   | 11.7805                   | 14.9580      | 17.4582      | 18.6111 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |            |          |               |               |          |                           |              |              |                |
|                                                                                     | 197.8100  | 199.8626  | 194.6900  | 183.6782   | 169.7776 | 156.7131      | 147.9852      | 145.9326 | 151.1052                  | 162.1171     | 176.0176     | 189.0821 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |            |          |               |               |          |                           |              |              |                |
|                                                                                     | 34.2573   | 34.2573   | 34.2573   | 34.2573    | 34.2573  | 34.2573       | 34.2573       | 34.2573  | 34.2573                   | 34.2573      | 34.2573      | 34.2573 (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)                                 |           |           |           |            |          |               |               |          |                           |              |              |                |
|                                                                                     | -90.0582  | -90.0582  | -90.0582  | -90.0582   | -90.0582 | -90.0582      | -90.0582      | -90.0582 | -90.0582                  | -90.0582     | -90.0582     | -90.0582 (71)  |
| Water heating gains (Table 5)                                                       |           |           |           |            |          |               |               |          |                           |              |              |                |
|                                                                                     | 40.8482   | 39.5539   | 36.8661   | 33.2121    | 30.8398  | 27.4995       | 24.6603       | 28.2981  | 29.5906                   | 33.3725      | 37.6430      | 39.5593 (72)   |
| Total internal gains                                                                | 313.5378  | 312.2715  | 301.4077  | 283.5643   | 264.7913 | 247.2335      | 236.1697      | 239.7795 | 249.2480                  | 267.2194     | 287.8906     | 304.0243 (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                  |              |              |                |
| Northeast                                                                           |           |           | 3.4300    | 11.2829    |          | 0.6300        | 0.7000        |          | 0.7700                    |              | 11.8274 (75) |                |
| Southwest                                                                           |           |           | 7.4900    | 36.7938    |          | 0.6300        | 0.7000        |          | 0.7700                    |              | 84.2226 (79) |                |
| Northwest                                                                           |           |           | 1.3200    | 11.2829    |          | 0.6300        | 0.7000        |          | 0.7700                    |              | 4.5516 (81)  |                |
| -----                                                                               |           |           |           |            |          |               |               |          |                           |              |              |                |
| Solar gains                                                                         | 100.6016  | 176.8022  | 256.3593  | 341.8634   | 405.0239 | 411.8198      | 392.9912      | 344.3839 | 285.7358                  | 199.3004     | 121.4883     | 85.4529 (83)   |
| Total gains                                                                         | 414.1394  | 489.0738  | 557.7670  | 625.4277   | 669.8153 | 659.0534      | 629.1610      | 584.1633 | 534.9838                  | 466.5199     | 409.3789     | 389.4772 (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                                                                                 | 56.8268   | 57.0113   | 57.1934   | 58.0643    | 58.2302  | 59.0152       | 59.0152       | 59.1629  | 58.7103                   | 58.2302      | 57.8956      | 57.5498        |
| alpha                                                                               | 4.7885    | 4.8008    | 4.8129    | 4.8710     | 4.8820   | 4.9343        | 4.9343        | 4.9442   | 4.9140                    | 4.8820       | 4.8597       | 4.8367         |
| util living area                                                                    | 0.9981    | 0.9955    | 0.9880    | 0.9616     | 0.8860   | 0.7290        | 0.5609        | 0.6199   | 0.8582                    | 0.9774       | 0.9961       | 0.9986 (86)    |
| MIT                                                                                 | 19.6539   | 19.8240   | 20.0941   | 20.4499    | 20.7540  | 20.9356       | 20.9858       | 20.9774  | 20.8484                   | 20.4493      | 19.9886      | 19.6304 (87)   |
| Th 2                                                                                | 19.9024   | 19.9056   | 19.9087   | 19.9232    | 19.9259  | 19.9387       | 19.9387       | 19.9410  | 19.9338                   | 19.9259      | 19.9204      | 19.9147 (88)   |
| util rest of house                                                                  | 0.9975    | 0.9940    | 0.9836    | 0.9466     | 0.8414   | 0.6357        | 0.4342        | 0.4914   | 0.7873                    | 0.9658       | 0.9944       | 0.9981 (89)    |
| MIT 2                                                                               | 18.6803   | 18.8522   | 19.1225   | 19.4806    | 19.7597  | 19.9092       | 19.9351       | 19.9346  | 19.8495                   | 19.4874      | 19.0287      | 18.6666 (90)   |
| Living area fraction                                                                |           |           |           |            |          |               |               |          | fLA = Living area / (4) = |              |              | 0.2224 (91)    |
| MIT                                                                                 | 18.8968   | 19.0683   | 19.3387   | 19.6962    | 19.9809  | 20.1375       | 20.1688       | 20.1666  | 20.0717                   | 19.7014      | 19.2422      | 18.8810 (92)   |
| Temperature adjustment                                                              |           |           |           |            |          |               |               |          |                           |              |              | 0.0000         |
| adjusted MIT                                                                        | 18.8968   | 19.0683   | 19.3387   | 19.6962    | 19.9809  | 20.1375       | 20.1688       | 20.1666  | 20.0717                   | 19.7014      | 19.2422      | 18.8810 (93)   |
| -----                                                                               |           |           |           |            |          |               |               |          |                           |              |              |                |
| 8. Space heating requirement                                                        |           |           |           |            |          |               |               |          |                           |              |              |                |
| -----                                                                               |           |           |           |            |          |               |               |          |                           |              |              |                |
| Utilisation                                                                         | Jan       | Feb       | Mar       | Apr        | May      | Jun           | Jul           | Aug      | Sep                       | Oct          | Nov          | Dec            |
|                                                                                     | 0.9967    | 0.9923    | 0.9805    | 0.9427     | 0.8441   | 0.6547        | 0.4627        | 0.5203   | 0.7980                    | 0.9626       | 0.9930       | 0.9975 (94)    |
| Useful gains                                                                        | 412.7529  | 485.3128  | 546.8914  | 589.5924   | 565.3648 | 431.4540      | 291.1239      | 303.9124 | 426.9217                  | 449.0728     | 406.4965     | 388.5031 (95)  |
| Ext temp.                                                                           | 4.3000    | 4.9000    | 6.5000    | 8.9000     | 11.7000  | 14.6000       | 16.6000       | 16.4000  | 14.1000                   | 10.6000      | 7.1000       | 4.2000 (96)    |
| Heat loss rate W                                                                    | 1252.5774 | 1211.8716 | 1094.6426 | 906.6935   | 693.4663 | 457.5601      | 294.8906      | 310.4534 | 496.0029                  | 762.1794     | 1022.7076    | 1243.9701 (97) |
| Month fracti                                                                        | 1.0000    | 1.0000    | 1.0000    | 1.0000     | 1.0000   | 1.0000        | 1.0000        | 1.0000   | 1.0000                    | 1.0000       | 1.0000       | 1.0000 (97a)   |
| Space heating kWh                                                                   | 624.8294  | 488.2475  | 407.5269  | 228.3128   | 95.3075  | 0.0000        | 0.0000        | 0.0000   | 0.0000                    | 232.9513     | 443.6720     | 636.4674 (98)  |
| Space heating                                                                       |           |           |           |            |          |               |               |          |                           |              |              | 3157.3149 (98) |
| Space heating per m2                                                                |           |           |           |            |          |               |               |          |                           | (98) / (4) = |              | 44.9632 (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   | 776.7165      | 611.4577      | 626.4159 | 0.0000                    | 0.0000       | 0.0000       | 0.0000 (100)   |
| Utilisation                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000     | 0.0000   | 0.8684        | 0.9268        | 0.9035   | 0.0000                    | 0.0000       | 0.0000       | 0.0000 (101)   |
| Useful loss                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000     | 0.0000   | 674.5107      | 566.7064      | 565.9763 | 0.0000                    | 0.0000       | 0.0000       | 0.0000 (102)   |
| Total gains                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000     | 0.0000   | 854.1596      | 817.5444      | 766.3662 | 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   | 129.3472      | 186.6235      | 149.0901 | 0.0000                    | 0.0000       | 0.0000       | 0.0000 (104)   |
| Space cooling                                                                       |           |           |           |            |          |               |               |          |                           |              |              | 465.0608 (104) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                        |        |        |        |        |        |         |         |         |        |        |                          |                |
|----------------------------------------|--------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------------------------|----------------|
| Cooled fraction                        |        |        |        |        |        |         |         |         |        |        | FC = cooled area / (4) = | 1.0000 (105)   |
| Intermittency factor (Table 10b)       | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500  | 0.2500  | 0.2500  | 0.0000 | 0.0000 | 0.0000                   | 0.0000 (106)   |
| Space cooling kWh                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 32.3368 | 46.6559 | 37.2725 | 0.0000 | 0.0000 | 0.0000                   | 0.0000 (107)   |
| Space cooling                          |        |        |        |        |        |         |         |         |        |        |                          | 116.2652 (107) |
| Space cooling per m2                   |        |        |        |        |        |         |         |         |        |        |                          | 1.6557 (108)   |
| Energy for space heating               |        |        |        |        |        |         |         |         |        |        |                          | 44.9632 (99)   |
| Energy for space cooling               |        |        |        |        |        |         |         |         |        |        |                          | 1.6557 (108)   |
| Total                                  |        |        |        |        |        |         |         |         |        |        |                          | 46.6189 (109)  |
| Target Fabric Energy Efficiency (TFEE) |        |        |        |        |        |         |         |         |        |        |                          | 53.6 (109)     |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total | m3 per hour               |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-------|---------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                                      | 0               | +                    | 0                           | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                                               |                 |                      |                             |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |                             |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                                              |                 |                      |                             |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                                             |                 |                      |                             |       | Yes                       |
| Measured/design AP50                                                      |                 |                      |                             |       | 4.1300                    |
| Infiltration rate                                                         |                 |                      |                             |       | 0.2065 (18)               |
| Number of sides sheltered                                                 |                 |                      |                             |       | 1 (19)                    |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |       | 0.9250 (20)               |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |       | 0.1910 (21)               |

|                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed                                   | 4.7000 | 4.4000 | 4.4000 | 4.0000 | 4.1000 | 3.9000 | 3.9000 | 3.8000 | 3.8000 | 4.1000 | 4.0000 | 4.1000 (22)  |
| Wind factor                                  | 1.1750 | 1.1000 | 1.1000 | 1.0000 | 1.0250 | 0.9750 | 0.9750 | 0.9500 | 0.9500 | 1.0250 | 1.0000 | 1.0250 (22a) |
| Adj infilt rate                              | 0.2244 | 0.2101 | 0.2101 | 0.1910 | 0.1958 | 0.1862 | 0.1862 | 0.1815 | 0.1815 | 0.1958 | 0.1910 | 0.1958 (22b) |
| Mechanical extract ventilation - centralised |        |        |        |        |        |        |        |        |        |        |        |              |
| If mechanical ventilation:                   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a) |
| Effective ac                                 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Front Door                                                     |                         |                            | 2.1200                    | 1.1000                        | 2.3320       |                                      | (26)            |
| Windows (Uw = 1.20)                                            |                         |                            | 12.2400                   | 1.1450                        | 14.0153      |                                      | (27)            |
| Ground Floor                                                   |                         |                            | 35.1100                   | 0.1200                        | 4.2132       | 84.0000                              | 2949.2400 (28a) |
| Brick and Block                                                | 84.9600                 | 14.3600                    | 70.6000                   | 0.2400                        | 16.9440      | 42.2200                              | 2980.7320 (29a) |
| Pitched Roof                                                   | 35.1100                 |                            | 35.1100                   | 0.1000                        | 3.5110       | 9.1000                               | 319.5010 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 155.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 41.0155      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 42.9400                   | 0.0000                        | 0.0000       | 70.0000                              | 3005.8000 (32)  |
| GF Stud                                                        |                         |                            | 60.0000                   |                               |              | 9.0000                               | 540.0000 (32c)  |
| First Floor                                                    |                         |                            | 74.5300                   |                               |              | 9.0000                               | 670.7700 (32c)  |
| Internal Floor 1                                               |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 11730.0030 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 167.0465 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.0959 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 47.1114 (37)    |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 (38) |
| Average = Sum(39)m / 12 =                                           | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 (39) |
| HLP                                                                 | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884 (40)  |
| HLP (average)                                                       |         |         |         |         |         |         |         |         |         |         |         | 1.0884 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

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

|                                          |     |     |     |     |     |     |     |     |     |     |     |              |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     | 2.2515 (42)  |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     | 87.6720 (43) |
| Daily hot water use                      | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec          |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy conte                                                    | 96.4392  | 92.9324  | 89.4255  | 85.9186  | 82.4117  | 78.9048  | 78.9048  | 82.4117  | 85.9186  | 89.4255  | 92.9324  | 96.4392 (44)   |
| Energy content (annual)                                         | 143.0166 | 125.0832 | 129.0747 | 112.5304 | 107.9756 | 93.1748  | 86.3401  | 99.0766  | 100.2598 | 116.8432 | 127.5435 | 138.5039 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 21.4525  | 18.7625  | 19.3612  | 16.8796  | 16.1963  | 13.9762  | 12.9510  | 14.8615  | 15.0390  | 17.5265  | 19.1315  | 1379.4225 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)    |
| Combi loss                                                      | 31.2121  | 28.1758  | 31.1694  | 30.1354  | 31.1192  | 30.0914  | 31.0795  | 31.1052  | 30.1154  | 31.1486  | 30.1769  | 31.2039 (61)   |
| Total heat required for water heating calculated for each month | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818 | 130.3752 | 147.9918 | 157.7204 | 169.7078 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818 | 130.3752 | 147.9918 | 157.7204 | 169.7078 (64)  |
| RHI water heating demand                                        |          |          |          |          |          |          |          |          |          |          |          |                |
| Heat gains from water heating, kWh/month                        | 55.3561  | 48.6341  | 50.7097  | 44.9502  | 43.6817  | 38.5035  | 36.4780  | 40.7193  | 40.8652  | 46.6375  | 49.9524  | 53.8535 (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                                                                               | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 45.2696  | 40.2081  | 32.6994  | 24.7556  | 18.5051  | 15.6228  | 16.8809  | 21.9425  | 29.4512  | 37.3950  | 43.6455  | 46.5278 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 295.2388 | 298.3024 | 290.5821 | 274.1465 | 253.3995 | 233.9002 | 220.8735 | 217.8098 | 225.5301 | 241.9658 | 262.7128 | 282.2121 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602 (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)                                 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 (71) |
| Water heating gains (Table 5)                                                       | 74.4033  | 72.3722  | 68.1582  | 62.4309  | 58.7120  | 53.4770  | 49.0295  | 54.7302  | 56.7573  | 62.6848  | 69.3784  | 72.3838 (72)  |
| Total internal gains                                                                | 513.7010 | 509.6720 | 490.2290 | 460.1222 | 429.4058 | 401.7892 | 385.5732 | 393.2718 | 410.5278 | 440.8349 | 474.5259 | 499.9129 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|---------------|
| <hr/>       |          |          |          |            |                                |                                   |                                    |          |          |                              |               |               |
| Northeast   |          |          |          | 3.4300     | 14.6130                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 15.3182 (75)  |               |
| Southwest   |          |          |          | 7.4900     | 45.0642                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 103.1538 (79) |               |
| Northwest   |          |          |          | 1.3200     | 14.6130                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 5.8950 (81)   |               |
| <hr/>       |          |          |          |            |                                |                                   |                                    |          |          |                              |               |               |
| Solar gains | 124.3670 | 186.5151 | 276.7759 | 372.9316   | 417.4858                       | 470.3403                          | 431.0043                           | 392.9134 | 323.7827 | 227.2687                     | 149.7944      | 99.9469 (83)  |
| Total gains | 638.0680 | 696.1871 | 767.0049 | 833.0538   | 846.8916                       | 872.1295                          | 816.5776                           | 786.1852 | 734.3106 | 668.1036                     | 624.3204      | 599.8598 (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                                                                         | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345                   | 42.6345 | 42.6345 | 42.6345      |
| alpha                                                                       | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423                    | 3.8423  | 3.8423  | 3.8423       |
| util living area                                                            | 0.9541  | 0.9365  | 0.8903  | 0.7935  | 0.6437  | 0.4355  | 0.3065  | 0.3086  | 0.5499                    | 0.8005  | 0.9209  | 0.9610 (86)  |
| MIT                                                                         | 19.9539 | 20.0899 | 20.3717 | 20.6833 | 20.8921 | 20.9817 | 20.9965 | 20.9965 | 20.9554                   | 20.7324 | 20.3137 | 19.9085 (87) |
| Th 2                                                                        | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103                   | 20.0103 | 20.0103 | 20.0103 (88) |
| util rest of house                                                          | 0.9444  | 0.9236  | 0.8683  | 0.7541  | 0.5810  | 0.3556  | 0.2158  | 0.2144  | 0.4645                    | 0.7521  | 0.9019  | 0.9525 (89)  |
| MIT 2                                                                       | 19.0922 | 19.2228 | 19.4903 | 19.7725 | 19.9440 | 20.0030 | 20.0096 | 20.0097 | 19.9897                   | 19.8224 | 19.4415 | 19.0488 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.2224 (91)  |
| MIT                                                                         | 19.2839 | 19.4157 | 19.6864 | 19.9751 | 20.1549 | 20.2207 | 20.2292 | 20.2292 | 20.2045                   | 20.0248 | 19.6355 | 19.2400 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.2839 | 19.4157 | 19.6864 | 19.9751 | 20.1549 | 20.2207 | 20.2292 | 20.2292 | 20.2045                   | 20.0248 | 19.6355 | 19.2400 (93) |

#### 8. Space heating requirement

|                          |           |           |          |          |          |          |          |          |          |          |          |                |
|--------------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation              | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains             | 0.9357    | 0.9143    | 0.8601   | 0.7526   | 0.5907   | 0.3729   | 0.2360   | 0.2354   | 0.4820   | 0.7529   | 0.8934   | 0.9443 (94)    |
| Ext temp.                | 5.6000    | 6.0000    | 7.6000   | 10.1000  | 13.1000  | 15.9000  | 17.7000  | 18.50965 | 353.9178 | 502.9967 | 557.7433 | 566.4487 (95)  |
| Heat loss rate W         | 1045.7863 | 1025.2918 | 923.6971 | 754.7047 | 539.1677 | 330.2069 | 193.2900 | 185.6506 | 367.1830 | 605.6543 | 843.3881 | 1034.7917 (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        | 333.8579  | 261.2399  | 196.4304 | 91.9799  | 28.9652  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.3773  | 205.6643 | 348.4472 (98)  |
| Space heating            |           |           |          |          |          |          |          |          |          |          |          | 1542.9620 (98) |
| RHI space heating demand |           |           |          |          |          |          |          |          |          |          |          | 1543 (98)      |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                      |        |        |        |        |        |        |        |        |        | main                         | secondary | other        | total | m3 per hour    |   |              |             |
|------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------------------------|-----------|--------------|-------|----------------|---|--------------|-------------|
|                                                      |        |        |        |        |        |        |        |        |        | heating                      | heating   |              |       |                |   |              |             |
| Number of chimneys                                   |        |        |        |        |        |        |        |        |        | 0                            | +         | 0            | +     | 0              | = | 0 * 40 =     | 0.0000 (6a) |
| Number of open flues                                 |        |        |        |        |        |        |        |        |        | 0                            | +         | 0            | +     | 0              | = | 0 * 20 =     | 0.0000 (6b) |
| Number of intermittent fans                          |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   | 0 * 10 =     | 0.0000 (7a) |
| Number of passive vents                              |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   | 0 * 10 =     | 0.0000 (7b) |
| Number of flueless gas fires                         |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   | 0 * 40 =     | 0.0000 (7c) |
| Infiltration due to chimneys, flues and fans         |        |        |        |        |        |        |        |        |        | = (6a)+(6b)+(7a)+(7b)+(7c) = |           |              |       | 0.0000 / (5) = |   | 0.0000 (8)   |             |
| Pressure test                                        |        |        |        |        |        |        |        |        |        |                              |           |              |       | Yes            |   |              |             |
| Measured/design AP50                                 |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   | 4.1300       |             |
| Infiltration rate                                    |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   | 0.2065 (18)  |             |
| Number of sides sheltered                            |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   | 1 (19)       |             |
| Shelter factor                                       |        |        |        |        |        |        |        |        |        | (20) = 1 - [0.075 x (19)] =  |           |              |       |                |   | 0.9250 (20)  |             |
| Infiltration rate adjusted to include shelter factor |        |        |        |        |        |        |        |        |        | (21) = (18) x (20) =         |           |              |       |                |   | 0.1910 (21)  |             |
|                                                      |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   |              |             |
| Wind speed                                           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct                          | Nov       | Dec          |       |                |   |              |             |
|                                                      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000                       | 4.5000    | 4.7000 (22)  |       |                |   |              |             |
| Wind factor                                          | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750                       | 1.1250    | 1.1750 (22a) |       |                |   |              |             |
| Adj infilt rate                                      |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   |              |             |
|                                                      | 0.2435 | 0.2388 | 0.2340 | 0.2101 | 0.2053 | 0.1815 | 0.1815 | 0.1767 | 0.1910 | 0.2053                       | 0.2149    | 0.2244 (22b) |       |                |   |              |             |
| Mechanical extract ventilation - centralised         |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   |              |             |
| If mechanical ventilation:                           |        |        |        |        |        |        |        |        |        |                              |           |              |       |                |   | 0.5000 (23a) |             |
| Effective ac                                         | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000                       | 0.5000    | 0.5000 (25)  |       |                |   |              |             |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Front Door                                                     |                         |                            | 2.1200                    | 1.1000                        | 2.3320       |                                      | (26)            |
| Windows (Uw = 1.20)                                            |                         |                            | 12.2400                   | 1.1450                        | 14.0153      |                                      | (27)            |
| Ground Floor                                                   |                         |                            | 35.1100                   | 0.1200                        | 4.2132       | 84.0000                              | 2949.2400 (28a) |
| Brick and Block                                                | 84.9600                 | 14.3600                    | 70.6000                   | 0.2400                        | 16.9440      | 42.2200                              | 2980.7320 (29a) |
| Pitched Roof                                                   | 35.1100                 |                            | 35.1100                   | 0.1000                        | 3.5110       | 9.1000                               | 319.5010 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 155.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 41.0155                       |              |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 42.9400                   | 0.0000                        | 0.0000       | 70.0000                              | 3005.8000 (32)  |
| GF Stud                                                        |                         |                            | 60.0000                   |                               |              | 9.0000                               | 540.0000 (32c)  |
| First Floor                                                    |                         |                            | 74.5300                   |                               |              | 9.0000                               | 670.7700 (32c)  |
| Internal Floor 1                                               |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 11730.0030 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 167.0465 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.0959 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 47.1114 (37)    |

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

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 (38) |
| Heat transfer coeff       | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 76.4247 (39) |
| HLP                       | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0884 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

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

Assumed occupancy 2.2515 (42)  
Average daily hot water use (litres/day) 87.6720 (43)

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



|                                                                 |          |          |          |          |          |          |          |                             |                   |            |            |           |      |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-----------------------------|-------------------|------------|------------|-----------|------|
| Energy conte                                                    | 143.0166 | 125.0832 | 129.0747 | 112.5304 | 107.9756 | 93.1748  | 86.3401  | 99.0766                     | 100.2598          | 116.8432   | 127.5435   | 138.5039  | (44) |
| Energy content (annual)                                         |          |          |          |          |          |          |          |                             |                   | Total =    | Sum(45)m = | 1379.4225 | (45) |
| Distribution loss                                               | (46)m =  | 0.15 x   | (45)m    |          |          |          |          |                             |                   |            |            |           |      |
|                                                                 | 21.4525  | 18.7625  | 19.3612  | 16.8796  | 16.1963  | 13.9762  | 12.9510  | 14.8615                     | 15.0390           | 17.5265    | 19.1315    | 20.7756   | (46) |
| Water storage loss:                                             |          |          |          |          |          |          |          |                             |                   |            |            |           |      |
| Total storage loss                                              |          |          |          |          |          |          |          |                             |                   |            |            |           |      |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000            | 0.0000     | 0.0000     | 0.0000    | (56) |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                             |                   |            |            |           |      |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000            | 0.0000     | 0.0000     | 0.0000    | (57) |
| Combi loss                                                      | 31.2121  | 28.1758  | 31.1694  | 30.1354  | 31.1192  | 30.0914  | 31.0795  | 31.1052                     | 30.1154           | 31.1486    | 30.1769    | 31.2039   | (61) |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                             |                   |            |            |           |      |
|                                                                 | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818                    | 130.3752          | 147.9918   | 157.7204   | 169.7078  | (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000            | 0.0000     | 0.0000     | 0.0000    | (63) |
|                                                                 |          |          |          |          |          |          |          | Solar input                 | (sum of months) = | Sum(63)m = |            | 0.0000    | (63) |
| Output from w/h                                                 |          |          |          |          |          |          |          |                             |                   |            |            |           |      |
|                                                                 | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818                    | 130.3752          | 147.9918   | 157.7204   | 169.7078  | (64) |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = | Sum(64)m =        |            |            | 1746.1553 | (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                             |                   |            |            |           |      |
|                                                                 | 55.3561  | 48.6341  | 50.7097  | 44.9502  | 43.6817  | 38.5035  | 36.4780  | 40.7193                     | 40.8652           | 46.6375    | 49.9524    | 53.8535   | (65) |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 45.2696  | 40.2081  | 32.6994  | 24.7556  | 18.5051  | 15.6228  | 16.8809  | 21.9425  | 29.4512  | 37.3950  | 43.6455  | 46.5278 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 295.2388 | 298.3024 | 290.5821 | 274.1465 | 253.3995 | 233.9002 | 220.8735 | 217.8098 | 225.5301 | 241.9658 | 262.7128 | 282.2121 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602 (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)                                 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 (71) |
| Water heating gains (Table 5)                                                       | 74.4033  | 72.3722  | 68.1582  | 62.4309  | 58.7120  | 53.4770  | 49.0295  | 54.7302  | 56.7573  | 62.6848  | 69.3784  | 72.3838 (72)  |
| Total internal gains                                                                | 513.7010 | 509.6720 | 490.2290 | 460.1222 | 429.4058 | 401.7892 | 385.5732 | 393.2718 | 410.5278 | 440.8349 | 474.5259 | 499.9129 (73) |

| [Jan      | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 3.4300     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 11.8274 (75) |
| Southwest | 7.4900     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 84.2226 (79) |
| Northwest | 1.3200     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 4.5516 (81)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

|                                                                       |          |          |          |          |          |          |          |          |          |           |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |           |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |           |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |           |          | 90.7000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |           |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |           |          | 2187.9088 | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov      | Dec       |        |
| Space heating requirement                                             | 404.4234 | 308.1382 | 246.9856 | 134.8143 | 55.5684  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 131.0161  | 279.0355 | 424.4516  | (98)   |
| Space heating efficiency (main heating system 1)                      | 90.7000  | 90.7000  | 90.7000  | 90.7000  | 90.7000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.7000   | 90.7000  | 90.7000   | (210)  |
| Space heating fuel (main heating system)                              | 445.8913 | 339.7334 | 272.3105 | 148.6376 | 61.2661  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 144.4500  | 307.6467 | 467.9731  | (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                                             | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818 | 130.3752 | 147.9918  | 157.7204 | 169.7078  | (64)   |
| Efficiency of water heater                                            | 89.5533  | 89.4366  | 89.2071  | 88.7592  | 88.0250  | 87.0000  | 87.0000  | 87.0000  | 87.0000  | 88.6991   | 89.3281  | 89.6115   | (216)  |
| (217)m                                                                | 89.5533  | 89.4366  | 89.2071  | 88.7592  | 88.0250  | 87.0000  | 87.0000  | 87.0000  | 87.0000  | 88.6991   | 89.3281  | 89.6115   | (217)  |
| Fuel for water heating, kWh/month                                     | 194.5532 | 171.3606 | 179.6315 | 160.7336 | 158.0173 | 141.6852 | 134.9651 | 149.6342 | 149.8566 | 166.8470  | 176.5630 | 189.3818  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |           |          | 1973.2292 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |           |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |           |          | 2187.9088 | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |           |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |           |          |           |        |
| (MEV)Centralised, Database: in-use factor = 1.4000, SFP = 0.4200)     |          |          |          |          |          |          |          |          |          |           |          |           |        |
| mechanical ventilation fans (SFP = 0.4200)                            |          |          |          |          |          |          |          |          |          |           |          | 91.0312   | (230a) |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |           |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |           |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |           |          | 166.0312  | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |           |          | 319.7904  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |          |          |          |           |          |           |        |
| PV Unit 0 (0.80 * 0.64 * 1029 * 1.00) =                               |          |          |          |          |          |          |          |          |          | -526.9436 |          | -526.9436 | (233)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |           |          | 4120.0160 | (238)  |

#### 10a. Fuel costs - using Table 12 prices

|                                       | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1         | 2187.9088        | 3.4800              | 76.1392 (240)       |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 1973.2292        | 3.4800              | 68.6684 (247)       |
| Mechanical ventilation fans           | 91.0312          | 13.1900             | 12.0070 (249)       |
| Pumps and fans for heating            | 75.0000          | 13.1900             | 9.8925 (249)        |
| Energy for lighting                   | 319.7904         | 13.1900             | 42.1804 (250)       |
| Additional standing charges           |                  |                     | 120.0000 (251)      |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | -526.9436        | 13.1900             | -69.5039 (252)      |
| Total energy cost                     |                  |                     | 259.3836 (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] = | 0.9455 (257) |
| SAP value                        |                                  | 86.8102      |
| SAP rating (Section 12)          |                                  | 87 (258)     |
| SAP band                         |                                  | B            |

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

|                                       | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1         | 2187.9088          | 0.2160                        | 472.5883 (261)           |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)            | 1973.2292          | 0.2160                        | 426.2175 (264)           |
| Space and water heating               |                    |                               | 898.8058 (265)           |
| Pumps and fans                        | 166.0312           | 0.5190                        | 86.1702 (267)            |
| Energy for lighting                   | 319.7904           | 0.5190                        | 165.9712 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -526.9436          | 0.5190                        | -273.4837 (269)          |
| Total kg/year                         |                    |                               | 877.4635 (272)           |
| CO2 emissions per m2                  |                    |                               | 12.5000 (273)            |
| EI value                              |                    |                               | 89.7952                  |
| EI rating                             |                    |                               | 90 (274)                 |
| EI band                               |                    |                               | B                        |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Calculation of stars for heating and DHW  
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|                                    |                                                                     |
|------------------------------------|---------------------------------------------------------------------|
| Main heating energy efficiency     | $3.48 \times (1 + 0.29 \times 0.00) / 0.9070 = 3.837$ , stars = 4   |
| Main heating environmental impact  | $0.216 \times (1 + 0.29 \times 0.00) / 0.9070 = 0.2381$ , stars = 4 |
| Water heating energy efficiency    | $3.48 / 0.8838 = 3.937$ , stars = 4                                 |
| Water heating environmental impact | $0.216 / 0.8838 = 0.2444$ , stars = 4                               |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                                         | main<br>heating | secondary<br>heating | other                     | total | m3 per hour               |
|-------------------------------------------------------------------------|-----------------|----------------------|---------------------------|-------|---------------------------|
| Number of chimneys                                                      | 0               | +                    | 0                         | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                                    | 0               | +                    | 0                         | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                                             |                 |                      |                           |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                                                 |                 |                      |                           |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                                            |                 |                      |                           |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) |                 |                      |                           |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                                           |                 |                      |                           |       | Yes                       |
| Measured/design AP50                                                    |                 |                      |                           |       | 4.1300                    |
| Infiltration rate                                                       |                 |                      |                           |       | 0.2065 (18)               |
| Number of sides sheltered                                               |                 |                      |                           |       | 1 (19)                    |
| Shelter factor                                                          |                 |                      | (20) = 1 - [0.075 x (19)] | =     | 0.9250 (20)               |
| Infiltration rate adjusted to include shelter factor                    |                 |                      | (21) = (18) x (20)        | =     | 0.1910 (21)               |

|                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed                                   | 4.7000 | 4.4000 | 4.4000 | 4.0000 | 4.1000 | 3.9000 | 3.9000 | 3.8000 | 3.8000 | 4.1000 | 4.0000 | 4.1000 (22)  |
| Wind factor                                  | 1.1750 | 1.1000 | 1.1000 | 1.0000 | 1.0250 | 0.9750 | 0.9750 | 0.9500 | 0.9500 | 1.0250 | 1.0000 | 1.0250 (22a) |
| Adj infilt rate                              | 0.2244 | 0.2101 | 0.2101 | 0.1910 | 0.1958 | 0.1862 | 0.1862 | 0.1815 | 0.1815 | 0.1958 | 0.1910 | 0.1958 (22b) |
| Mechanical extract ventilation - centralised |        |        |        |        |        |        |        |        |        |        |        |              |
| If mechanical ventilation:                   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a) |
| Effective ac                                 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Front Door                                                     |                         |                            | 2.1200                    | 1.1000                        | 2.3320       |                                      | (26)            |
| Windows (Uw = 1.20)                                            |                         |                            | 12.2400                   | 1.1450                        | 14.0153      |                                      | (27)            |
| Ground Floor                                                   |                         |                            | 35.1100                   | 0.1200                        | 4.2132       | 84.0000                              | 2949.2400 (28a) |
| Brick and Block                                                | 84.9600                 | 14.3600                    | 70.6000                   | 0.2400                        | 16.9440      | 42.2200                              | 2980.7320 (29a) |
| Pitched Roof                                                   | 35.1100                 |                            | 35.1100                   | 0.1000                        | 3.5110       | 9.1000                               | 319.5010 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 155.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 41.0155                       |              |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 42.9400                   | 0.0000                        | 0.0000       | 70.0000                              | 3005.8000 (32)  |
| GF Stud                                                        |                         |                            | 60.0000                   |                               |              | 9.0000                               | 540.0000 (32c)  |
| First Floor                                                    |                         |                            | 74.5300                   |                               |              | 9.0000                               | 670.7700 (32c)  |
| Internal Floor 1                                               |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 11730.0030 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 167.0465 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.0959 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 47.1114 (37)    |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 (38) |
| Average = Sum(39)m / 12 =                                           | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 (39) |
| HLP                                                                 | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

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

|                                          |     |     |     |     |     |     |     |     |     |     |     |              |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     | 2.2515 (42)  |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     | 87.6720 (43) |
| Daily hot water use                      | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec          |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                                                 |          |          |          |          |          |          |          |                                           |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 96.4392  | 92.9324  | 89.4255  | 85.9186  | 82.4117  | 78.9048  | 78.9048  | 82.4117                                   | 85.9186  | 89.4255             | 92.9324  | 96.4392 (44)   |
| Energy content (annual)                                         | 143.0166 | 125.0832 | 129.0747 | 112.5304 | 107.9756 | 93.1748  | 86.3401  | 99.0766                                   | 100.2598 | 116.8432            | 127.5435 | 138.5039 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |                                           |          | Total = Sum (45)m = |          | 1379.4225 (45) |
|                                                                 | 21.4525  | 18.7625  | 19.3612  | 16.8796  | 16.1963  | 13.9762  | 12.9510  | 14.8615                                   | 15.0390  | 17.5265             | 19.1315  | 20.7756 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |                                           |          |                     |          |                |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000              | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000              | 0.0000   | 0.0000 (57)    |
| Combi loss                                                      | 31.2121  | 28.1758  | 31.1694  | 30.1354  | 31.1192  | 30.0914  | 31.0795  | 31.1052                                   | 30.1154  | 31.1486             | 30.1769  | 31.2039 (61)   |
| Total heat required for water heating calculated for each month | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818                                  | 130.3752 | 147.9918            | 157.7204 | 169.7078 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818                                  | 130.3752 | 147.9918            | 157.7204 | 169.7078 (64)  |
| Heat gains from water heating, kWh/month                        | 55.3561  | 48.6341  | 50.7097  | 44.9502  | 43.6817  | 38.5035  | 36.4780  | 40.7193                                   | 40.8652  | 46.6375             | 49.9524  | 53.8535 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   |          |                     |          | 1746.1553 (64) |

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

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| (66)m                                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|                                                                                     | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 45.2696  | 40.2081  | 32.6994  | 24.7556  | 18.5051  | 15.6228  | 16.8809  | 21.9425  | 29.4512  | 37.3950  | 43.6455  | 46.5278 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 295.2388 | 298.3024 | 290.5821 | 274.1465 | 253.3995 | 233.9002 | 220.8735 | 217.8098 | 225.5301 | 241.9658 | 262.7128 | 282.2121 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602 (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)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 74.4033  | 72.3722  | 68.1582  | 62.4309  | 58.7120  | 53.4770  | 49.0295  | 54.7302  | 56.7573  | 62.6848  | 69.3784  | 72.3838 (72)  |
| Total internal gains                                                                | 513.7010 | 509.6720 | 490.2290 | 460.1222 | 429.4058 | 401.7892 | 385.5732 | 393.2718 | 410.5278 | 440.8349 | 474.5259 | 499.9129 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|----------|---------------|
| Northeast   |          |          |          | 3.4300     | 14.6130                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 15.3182 (75)  |          |               |
| Southwest   |          |          |          | 7.4900     | 45.0642                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 103.1538 (79) |          |               |
| Northwest   |          |          |          | 1.3200     | 14.6130                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 5.8950 (81)   |          |               |
| -----       |          |          |          |            |                                |                                   |                                    |                              |          |               |          |               |
| Solar gains | 124.3670 | 186.5151 | 276.7759 | 372.9316   | 417.4858                       | 470.3403                          | 431.0043                           | 392.9134                     | 323.7827 | 227.2687      | 149.7944 | 99.9469 (83)  |
| Total gains | 638.0680 | 696.1871 | 767.0049 | 833.0538   | 846.8916                       | 872.1295                          | 816.5776                           | 786.1852                     | 734.3106 | 668.1036      | 624.3204 | 599.8598 (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                                                                         | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345                   | 42.6345 | 42.6345 | 42.6345      |
| alpha                                                                       | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423                    | 3.8423  | 3.8423  | 3.8423       |
| util living area                                                            | 0.9541  | 0.9365  | 0.8903  | 0.7935  | 0.6437  | 0.4355  | 0.3065  | 0.3086  | 0.5499                    | 0.8005  | 0.9209  | 0.9610 (86)  |
| MIT                                                                         | 19.9539 | 20.0899 | 20.3717 | 20.6833 | 20.8921 | 20.9817 | 20.9965 | 20.9965 | 20.9554                   | 20.7324 | 20.3137 | 19.9085 (87) |
| Th 2                                                                        | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103                   | 20.0103 | 20.0103 | 20.0103 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | 0.9444  | 0.9236  | 0.8683  | 0.7541  | 0.5810  | 0.3556  | 0.2158  | 0.2144  | 0.4645                    | 0.7521  | 0.9019  | 0.9525 (89)  |
| MIT 2                                                                       | 19.0922 | 19.2228 | 19.4903 | 19.7725 | 19.9440 | 20.0030 | 20.0096 | 20.0097 | 19.9897                   | 19.8224 | 19.4415 | 19.0488 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.2224 (91)  |
| MIT                                                                         | 19.2839 | 19.4157 | 19.6864 | 19.9751 | 20.1549 | 20.2207 | 20.2292 | 20.2292 | 20.2045                   | 20.0248 | 19.6355 | 19.2400 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.2839 | 19.4157 | 19.6864 | 19.9751 | 20.1549 | 20.2207 | 20.2292 | 20.2292 | 20.2045                   | 20.0248 | 19.6355 | 19.2400 (93) |

#### 8. Space heating requirement

|                                  |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation                      | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                                  | 0.9357    | 0.9143    | 0.8601   | 0.7526   | 0.5907   | 0.3729   | 0.2360   | 0.2354   | 0.4820   | 0.7529       | 0.8934   | 0.9443 (94)    |
| Useful gains                     | 597.0526  | 636.5420  | 659.6777 | 626.9549 | 500.2360 | 325.2474 | 192.7081 | 185.0965 | 353.9178 | 502.9967     | 557.7433 | 566.4487 (95)  |
| Ext temp.                        | 5.6000    | 6.0000    | 7.6000   | 10.1000  | 13.1000  | 15.9000  | 17.7000  | 17.8000  | 15.4000  | 12.1000      | 8.6000   | 5.7000 (96)    |
| Heat loss rate W                 | 1045.7863 | 1025.2918 | 923.6971 | 754.7047 | 539.1677 | 330.2069 | 193.2900 | 185.6506 | 367.1830 | 605.6543     | 843.3881 | 1034.7917 (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                | 333.8579  | 261.2399  | 196.4304 | 91.9799  | 28.9652  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.3773      | 205.6643 | 348.4472 (98)  |
| Space heating                    |           |           |          |          |          |          |          |          |          |              |          | 1542.9620 (98) |
| Space heating per m <sup>2</sup> |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 21.9733 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

8c. Space cooling requirement

Not applicable

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

|                                                                       |          |          |          |          |          |          |          |          |          |           |          |           |        |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |           |          | 0.0000    | (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |           |          | 1.0000    | (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |           |          | 90.7000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |           |          | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |           |          | 1701.1709 | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov      | Dec       |        |
| Space heating requirement                                             | 333.8579 | 261.2399 | 196.4304 | 91.9799  | 28.9652  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.3773   | 205.6643 | 348.4472  | (98)   |
| Space heating efficiency (main heating system 1)                      | 90.7000  | 90.7000  | 90.7000  | 90.7000  | 90.7000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.7000   | 90.7000  | 90.7000   | (210)  |
| Space heating fuel (main heating system)                              | 368.0903 | 288.0264 | 216.5715 | 101.4111 | 31.9352  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.2087   | 226.7522 | 384.1756  | (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                                             | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948 | 123.2662 | 117.4197 | 130.1818 | 130.3752 | 147.9918  | 157.7204 | 169.7078  | (64)   |
| Efficiency of water heater                                            | 89.3963  | 89.2958  | 88.9995  | 88.4138  | 87.6160  | 87.0000  | 87.0000  | 87.0000  | 87.0000  | 88.2251   | 89.0561  | 89.4540   | (216)  |
| (217)m                                                                |          |          |          |          |          |          |          |          |          |           |          |           | (217)  |
| Fuel for water heating, kWh/month                                     | 194.8949 | 171.6306 | 180.0506 | 161.3615 | 158.7550 | 141.6852 | 134.9651 | 149.6342 | 149.8566 | 167.7433  | 177.1022 | 189.7152  | (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |           |          | 1977.3945 | (219)  |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |           |          |           |        |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |           |          | 1701.1709 | (211)  |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |           |          | 0.0000    | (215)  |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |           |          |           |        |
| (MEV)Centralised, Database: in-use factor = 1.4000, SFP = 0.4200)     |          |          |          |          |          |          |          |          |          |           |          |           |        |
| mechanical ventilation fans (SFP = 0.4200)                            |          |          |          |          |          |          |          |          |          |           |          | 91.0312   | (230a) |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |           |          | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |           |          | 45.0000   | (230e) |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |           |          | 166.0312  | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |           |          | 319.7904  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |          |          |          |           |          |           |        |
| PV Unit 0 (0.80 * 0.64 * 1154 * 1.00) =                               |          |          |          |          |          |          |          |          |          | -591.0819 |          | -591.0819 | (233)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |           |          | 3573.3052 | (238)  |

10a. Fuel costs - using BEDF prices (491)

|                                       | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1         | 1701.1709        | 3.6300              | 61.7525 (240)       |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 1977.3945        | 3.6300              | 71.7794 (247)       |
| Mechanical ventilation fans           | 91.0312          | 19.4400             | 17.6965 (249)       |
| Pumps and fans for heating            | 75.0000          | 19.4400             | 14.5800 (249)       |
| Energy for lighting                   | 319.7904         | 19.4400             | 62.1673 (250)       |
| Additional standing charges           |                  |                     | 95.0000 (251)       |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | -591.0819        | 19.4400             | -114.9063 (252)     |
| Total energy cost                     |                  |                     | 208.0693 (255)      |

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

|                                       | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1         | 1701.1709          | 0.2160                        | 367.4529 (261)           |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)            | 1977.3945          | 0.2160                        | 427.1172 (264)           |
| Space and water heating               |                    |                               | 794.5701 (265)           |
| Pumps and fans                        | 166.0312           | 0.5190                        | 86.1702 (267)            |
| Energy for lighting                   | 319.7904           | 0.5190                        | 165.9712 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -591.0819          | 0.5190                        | -306.7715 (269)          |
| Total kg/year                         |                    |                               | 739.9401 (272)           |

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

|                               | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|-------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1 | 1701.1709          | 1.2200                              | 2075.4285 (261)            |
| Space heating - secondary     | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)    | 1977.3945          | 1.2200                              | 2412.4212 (264)            |
| Space and water heating       |                    |                                     | 4487.8497 (265)            |
| Pumps and fans                | 166.0312           | 3.0700                              | 509.7159 (267)             |
| Energy for lighting           | 319.7904           | 3.0700                              | 981.7567 (268)             |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                       |           |        |                  |
|---------------------------------------|-----------|--------|------------------|
| Energy saving/generation technologies |           |        |                  |
| PV Unit                               | -591.0819 | 3.0700 | -1814.6214 (269) |
| Primary energy kWh/year               |           |        | 4164.7010 (272)  |
| Primary energy kWh/m2/year            |           |        | 59.3093 (273)    |

#### SAP 2012 EPC IMPROVEMENTS

|                                      |      |
|--------------------------------------|------|
| Current energy efficiency rating:    | B 87 |
| Current environmental impact rating: | B 90 |

(For testing purposes):

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

|                       |            |             |                 |
|-----------------------|------------|-------------|-----------------|
| Recommended measures: | SAP change | Cost change | CO2 change      |
| N Solar water heating | + 1.3      | -£ 26       | -184 kg (24.9%) |

| Recommended measures | Typical annual savings | Energy efficiency | Environmental impact |
|----------------------|------------------------|-------------------|----------------------|
| Solar water heating  | £26 2.63 kg/m²         | B 88              | A 92                 |
| Total Savings        | £26 2.63 kg/m²         |                   |                      |

|                                        |      |
|----------------------------------------|------|
| Potential energy efficiency rating:    | B 88 |
| Potential environmental impact rating: | A 92 |

Fuel prices for cost data on this page from database revision number 491 TEST (28 Feb 2022)  
Recommendation texts revision number 4.9c (22 Feb 2014)

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

|                          | Current    | Potential  | Saving     |
|--------------------------|------------|------------|------------|
| Electricity              | £94        | £104       | -£10       |
| Mains gas                | £229       | £193       | £35        |
| Space heating            | £189       | £189       | £0         |
| Water heating            | £72        | £46        | £26        |
| Lighting                 | £62        | £62        | £0         |
| Generated (PV)           | -£115      | -£115      | £0         |
| Total cost of fuels      | £208       | £182       | £25        |
| Total cost of uses       | £208       | £182       | £26        |
| Delivered energy         | 51 kWh/m²  | 38 kWh/m²  | 13 kWh/m²  |
| Carbon dioxide emissions | 0.7 tonnes | 0.6 tonnes | 0.2 tonnes |
| CO2 emissions per m²     | 11 kg/m²   | 8 kg/m²    | 3 kg/m²    |
| Primary energy           | 59 kWh/m²  | 45 kWh/m²  | 15 kWh/m²  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                                           |        |        |        |        | main<br>heating | secondary<br>heating | other  |        | total  | m3 per hour |                             |              |
|---------------------------------------------------------------------------|--------|--------|--------|--------|-----------------|----------------------|--------|--------|--------|-------------|-----------------------------|--------------|
| Number of chimneys                                                        |        |        |        |        | 0               | +                    | 0      | +      | 0      | =           | 0 * 40 =                    | 0.0000 (6a)  |
| Number of open flues                                                      |        |        |        |        | 0               | +                    | 0      | +      | 0      | =           | 0 * 20 =                    | 0.0000 (6b)  |
| Number of intermittent fans                                               |        |        |        |        |                 |                      |        |        |        |             | 0 * 10 =                    | 0.0000 (7a)  |
| Number of passive vents                                                   |        |        |        |        |                 |                      |        |        |        |             | 0 * 10 =                    | 0.0000 (7b)  |
| Number of flueless gas fires                                              |        |        |        |        |                 |                      |        |        |        |             | 0 * 40 =                    | 0.0000 (7c)  |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |        |        |        |        |                 |                      |        |        |        |             | 0.0000 / (5) =              | 0.0000 (8)   |
| Pressure test                                                             |        |        |        |        |                 |                      |        |        |        |             | Yes                         |              |
| Measured/design AP50                                                      |        |        |        |        |                 |                      |        |        |        |             | 4.1300                      |              |
| Infiltration rate                                                         |        |        |        |        |                 |                      |        |        |        |             | 0.2065 (18)                 |              |
| Number of sides sheltered                                                 |        |        |        |        |                 |                      |        |        |        |             | 1 (19)                      |              |
| Shelter factor                                                            |        |        |        |        |                 |                      |        |        |        |             | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)  |
| Infiltration rate adjusted to include shelter factor                      |        |        |        |        |                 |                      |        |        |        |             | (21) = (18) x (20) =        | 0.1910 (21)  |
| Wind speed                                                                | Jan    | Feb    | Mar    | Apr    | May             | Jun                  | Jul    | Aug    | Sep    | Oct         | Nov                         | Dec          |
|                                                                           | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000          | 3.8000               | 3.8000 | 3.7000 | 4.0000 | 4.3000      | 4.5000                      | 4.7000 (22)  |
| Wind factor                                                               | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750          | 0.9500               | 0.9500 | 0.9250 | 1.0000 | 1.0750      | 1.1250                      | 1.1750 (22a) |
| Adj infilt rate                                                           | 0.2435 | 0.2388 | 0.2340 | 0.2101 | 0.2053          | 0.1815               | 0.1815 | 0.1767 | 0.1910 | 0.2053      | 0.2149                      | 0.2244 (22b) |
| Mechanical extract ventilation - centralised                              |        |        |        |        |                 |                      |        |        |        |             |                             |              |
| If mechanical ventilation:                                                |        |        |        |        |                 |                      |        |        |        |             |                             | 0.5000 (23a) |
| Effective ac                                                              | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000          | 0.5000               | 0.5000 | 0.5000 | 0.5000 | 0.5000      | 0.5000                      | 0.5000 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Front Door                                                     |                         |                            | 2.1200                    | 1.1000                        | 2.3320       |                                      | (26)            |
| Windows (Uw = 1.20)                                            |                         |                            | 12.2400                   | 1.1450                        | 14.0153      |                                      | (27)            |
| Ground Floor                                                   |                         |                            | 35.1100                   | 0.1200                        | 4.2132       | 84.0000                              | 2949.2400 (28a) |
| Brick and Block                                                | 84.9600                 | 14.3600                    | 70.6000                   | 0.2400                        | 16.9440      | 42.2200                              | 2980.7320 (29a) |
| Pitched Roof                                                   | 35.1100                 |                            | 35.1100                   | 0.1000                        | 3.5110       | 9.1000                               | 319.5010 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 155.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 41.0155                       |              |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 42.9400                   | 0.0000                        | 0.0000       | 70.0000                              | 3005.8000 (32)  |
| GF Stud                                                        |                         |                            | 60.0000                   |                               |              | 9.0000                               | 540.0000 (32c)  |
| First Floor                                                    |                         |                            | 74.5300                   |                               |              | 9.0000                               | 670.7700 (32c)  |
| Internal Floor 1                                               |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 11730.0030 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 167.0465 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.0959 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 47.1114 (37)    |

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

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 | 29.3133 (38) |
| Heat transfer coeff       | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 | 76.4247 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 76.4247 (39) |
| HLP                       | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884  | 1.0884 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0884 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

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

Assumed occupancy 2.2515 (42)  
Average daily hot water use (litres/day) 87.6720 (43)

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                                                 |          |          |          |          |           |           |           |                               |             |                     |          |                 |
|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|-------------------------------|-------------|---------------------|----------|-----------------|
| Energy conte                                                    | 96.4392  | 92.9324  | 89.4255  | 85.9186  | 82.4117   | 78.9048   | 78.9048   | 82.4117                       | 85.9186     | 89.4255             | 92.9324  | 96.4392 (44)    |
| Energy content (annual)                                         | 143.0166 | 125.0832 | 129.0747 | 112.5304 | 107.9756  | 93.1748   | 86.3401   | 99.0766                       | 100.2598    | 116.8432            | 127.5435 | 138.5039 (45)   |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |           |           |           |                               |             | Total = Sum (45)m = |          | 1379.4225 (45)  |
|                                                                 | 21.4525  | 18.7625  | 19.3612  | 16.8796  | 16.1963   | 13.9762   | 12.9510   | 14.8615                       | 15.0390     | 17.5265             | 19.1315  | 20.7756 (46)    |
| Water storage loss:                                             |          |          |          |          |           |           |           |                               |             |                     |          |                 |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000                        | 0.0000      | 0.0000              | 0.0000   | 0.0000 (56)     |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000                        | 0.0000      | 0.0000              | 0.0000   | 0.0000 (57)     |
| Combi loss                                                      | 31.2121  | 28.1758  | 31.1694  | 30.1354  | 31.1192   | 30.0914   | 31.0795   | 31.1052                       | 30.1154     | 31.1486             | 30.1769  | 31.2039 (61)    |
| Total heat required for water heating calculated for each month | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948  | 123.2662  | 117.4197  | 130.1818                      | 130.3752    | 147.9918            | 157.7204 | 169.7078 (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                                             |          |          |          |          |           |           |           |                               |             |                     |          | 1.3148 (H8)     |
| Utilisation factor                                              |          |          |          |          |           |           |           |                               |             |                     |          | 0.5326 (H9)     |
| Collector performance factor                                    |          |          |          |          |           |           |           |                               |             |                     |          | 0.8793 (H10)    |
| Dedicated solar storage volume                                  |          |          |          |          |           |           |           |                               |             |                     |          | 75.0000 (H11)   |
| Effective solar volume                                          |          |          |          |          |           |           |           |                               |             |                     |          | 75.0000 (H13)   |
| Daily hot water demand                                          |          |          |          |          |           |           |           |                               |             |                     |          | 87.6720 (H14)   |
| Volume ratio Veff/V                                             |          |          |          |          |           |           |           |                               |             |                     |          | 0.8555 (H15)    |
| Solar storage volume factor                                     |          |          |          |          |           |           |           |                               |             |                     |          | 0.9688 (H16)    |
| Solar input                                                     |          |          |          |          |           |           |           |                               |             |                     |          | -822.8328 (H17) |
| Solar input                                                     | -23.8605 | -39.8163 | -67.8118 | -90.8811 | -112.2760 | -110.3852 | -108.9264 | -95.1695                      | -74.5368    | -50.8999            | -28.3020 | -19.9672 (63)   |
|                                                                 |          |          |          |          |           |           |           | Solar input (sum of months) = | Sum (63)m = |                     |          | -822.8328 (63)  |
| Output from w/h                                                 | 150.3682 | 113.4427 | 92.4323  | 51.7847  | 26.8188   | 12.8810   | 8.4933    | 35.0122                       | 55.8384     | 97.0919             | 129.4184 | 149.7406 (64)   |
|                                                                 |          |          |          |          |           |           |           | Total per year (kWh/year) =   | Sum (64)m = |                     |          | 923.3225 (64)   |
| Heat gains from water heating, kWh/month                        | 55.3561  | 48.6341  | 50.7097  | 44.9502  | 43.6817   | 38.5035   | 36.4780   | 40.7193                       | 40.8652     | 46.6375             | 49.9524  | 53.8535 (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                                                                               | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 45.2696  | 40.2081  | 32.6994  | 24.7556  | 18.5051  | 15.6228  | 16.8809  | 21.9425  | 29.4512  | 37.3950  | 43.6455  | 46.5278  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 295.2388 | 298.3024 | 290.5821 | 274.1465 | 253.3995 | 233.9002 | 220.8735 | 217.8098 | 225.5301 | 241.9658 | 262.7128 | 282.2121 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | (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)                                 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | (71) |
| Water heating gains (Table 5)                                                       | 74.4033  | 72.3722  | 68.1582  | 62.4309  | 58.7120  | 53.4770  | 49.0295  | 54.7302  | 56.7573  | 62.6848  | 69.3784  | 72.3838  | (72) |
| Total internal gains                                                                | 513.7010 | 509.6720 | 490.2290 | 460.1222 | 429.4058 | 401.7892 | 385.5732 | 393.2718 | 410.5278 | 440.8349 | 474.5259 | 499.9129 | (73) |

#### 6. Solar gains

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 3.4300     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 11.8274 (75) |
| Southwest | 7.4900     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 84.2226 (79) |
| Northwest | 1.3200     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 4.5516 (81)  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 100.6016 | 176.8022 | 256.3593 | 341.8634 | 405.0239 | 411.8198 | 392.9912 | 344.3839 | 285.7358 | 199.3004 | 121.4883 | 85.4529 (83)  |
| Total gains | 614.3026 | 686.4742 | 746.5883 | 801.9856 | 834.4297 | 813.6091 | 778.5645 | 737.6556 | 696.2636 | 640.1353 | 596.0142 | 585.3659 (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                                                                         | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345                   | 42.6345 | 42.6345 | 42.6345      |
| alpha                                                                       | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423                    | 3.8423  | 3.8423  | 3.8423       |
| util living area                                                            |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | 0.9678  | 0.9501  | 0.9161  | 0.8459  | 0.7256  | 0.5641  | 0.4220  | 0.4617  | 0.6720                    | 0.8695  | 0.9493  | 0.9728 (86)  |
| MIT                                                                         | 19.7449 | 19.9354 | 20.2190 | 20.5464 | 20.8061 | 20.9444 | 20.9858 | 20.9798 | 20.8905                   | 20.5615 | 20.0859 | 19.6846 (87) |
| Th 2                                                                        | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103                   | 20.0103 | 20.0103 | 20.0103 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | 0.9613  | 0.9402  | 0.8994  | 0.8155  | 0.6743  | 0.4889  | 0.3314  | 0.3687  | 0.5995                    | 0.8370  | 0.9375  | 0.9672 (89)  |
| MIT 2                                                                       | 18.8871 | 19.0726 | 19.3457 | 19.6512 | 19.8769 | 19.9815 | 20.0056 | 20.0030 | 19.9472                   | 19.6727 | 19.2225 | 18.8281 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.2224 (91)  |
| MIT                                                                         | 19.0779 | 19.2645 | 19.5399 | 19.8503 | 20.0836 | 20.1957 | 20.2236 | 20.2203 | 20.1570                   | 19.8704 | 19.4146 | 19.0186 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.0779 | 19.2645 | 19.5399 | 19.8503 | 20.0836 | 20.1957 | 20.2236 | 20.2203 | 20.1570                   | 19.8704 | 19.4146 | 19.0186 (93) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov          | Dec       |       |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-----------|-------|
| Utilisation          | 0.9536    | 0.9312    | 0.8902   | 0.8100   | 0.6783   | 0.5036   | 0.3514   | 0.3889   | 0.6109   | 0.8317   | 0.9288       | 0.9601    | (94)  |
| Useful gains         | 585.8154  | 639.2649  | 664.6021 | 649.6338 | 566.0260 | 409.7146 | 273.5486 | 286.8975 | 425.3800 | 532.3888 | 553.5884     | 562.0109  | (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     | 1129.3952 | 1097.8039 | 996.5720 | 836.8760 | 640.7147 | 427.6485 | 276.9332 | 291.9652 | 462.9064 | 708.4858 | 941.1377     | 1132.5104 | (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    | 404.4234  | 308.1382  | 246.9856 | 134.8143 | 55.5684  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 131.0161 | 279.0355     | 424.4516  | (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |          |              | 1984.4333 | (98)  |
| Space heating per m2 |           |           |          |          |          |          |          |          |          |          | (98) / (4) = | 28.2602   | (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 %)                      |          |          |          |          |         |         |         |         |         |          |          |           | 90.7000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |         |         |         |         |         |          |          |           | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |         |         |         |         |         |          |          |           | 2187.9088 | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec       |           |        |
| Space heating requirement                                             | 404.4234 | 308.1382 | 246.9856 | 134.8143 | 55.5684 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 131.0161 | 279.0355 | 424.4516  | (98)      |        |
| Space heating efficiency (main heating system 1)                      | 90.7000  | 90.7000  | 90.7000  | 90.7000  | 90.7000 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 90.7000  | 90.7000  | 90.7000   | (210)     |        |
| Space heating fuel (main heating system)                              | 445.8913 | 339.7334 | 272.3105 | 148.6376 | 61.2661 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 144.4500 | 307.6467 | 467.9731  | (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                                             | 150.3682 | 113.4427 | 92.4323  | 51.7847  | 26.8188 | 12.8810 | 8.4933  | 35.0122 | 55.8384 | 97.0919  | 129.4184 | 149.7406  | (64)      |        |
| Efficiency of water heater                                            | 89.6664  | 89.6738  | 89.6616  | 89.6420  | 89.4615 | 87.0000 | 87.0000 | 87.0000 | 87.0000 | 89.0873  | 89.4940  | 89.7051   | (216)     |        |
| Fuel for water heating, kWh/month                                     | 167.6974 | 126.5060 | 103.0902 | 57.7684  | 29.9781 | 14.8057 | 9.7624  | 40.2439 | 64.1820 | 108.9851 | 144.6111 | 166.9255  | (219)     |        |
| Water heating fuel used                                               |          |          |          |          |         |         |         |         |         |          |          | 1034.5557 | (219)     |        |
| Annual totals kWh/year                                                |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| Space heating fuel - main system                                      |          |          |          |          |         |         |         |         |         |          |          | 2187.9088 | (211)     |        |
| Space heating fuel - secondary                                        |          |          |          |          |         |         |         |         |         |          |          | 0.0000    | (215)     |        |
| Electricity for pumps and fans:                                       |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| (MEV)Centralised, Database: in-use factor = 1.4000, SFP = 0.4200)     |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| mechanical ventilation fans (SFP = 0.4200)                            |          |          |          |          |         |         |         |         |         |          |          |           | 91.0312   | (230a) |
| central heating pump                                                  |          |          |          |          |         |         |         |         |         |          |          |           | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |         |         |         |         |         |          |          |           | 45.0000   | (230e) |
| pump for solar water heating                                          |          |          |          |          |         |         |         |         |         |          |          |           | 50.0000   | (230g) |
| Total electricity for the above, kWh/year                             |          |          |          |          |         |         |         |         |         |          |          |           | 216.0312  | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |         |         |         |         |         |          |          |           | 319.7904  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| PV Unit 0 (0.80 * 0.64 * 1029 * 1.00) =                               |          |          |          |          |         |         |         |         |         |          |          |           | -526.9436 | (233)  |
| Total delivered energy for all uses                                   |          |          |          |          |         |         |         |         |         |          |          |           | 3231.3426 | (238)  |

#### 10a. Fuel costs - using Table 12 prices

|                                       | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |       |
|---------------------------------------|---------------|------------------|------------------|-------|
| Space heating - main system 1         | 2187.9088     | 3.4800           | 76.1392          | (240) |
| Space heating - secondary             | 0.0000        | 0.0000           | 0.0000           | (242) |
| Water heating (other fuel)            | 1034.5557     | 3.4800           | 36.0025          | (247) |
| Mechanical ventilation fans           | 91.0312       | 13.1900          | 12.0070          | (249) |
| Pumps and fans for heating            | 75.0000       | 13.1900          | 9.8925           | (249) |
| Pump for solar water heating          | 50.0000       | 13.1900          | 6.5950           | (249) |
| Energy for lighting                   | 319.7904      | 13.1900          | 42.1804          | (250) |
| Additional standing charges           |               |                  | 120.0000         | (251) |
| Energy saving/generation technologies |               |                  |                  |       |
| PV Unit                               | -526.9436     | 13.1900          | -69.5039         | (252) |
| Total energy cost                     |               |                  | 233.3128         | (255) |

#### 11a. SAP rating - Individual heating systems

|                                  |                                  |         |       |
|----------------------------------|----------------------------------|---------|-------|
| Energy cost deflator (Table 12): |                                  | 0.4200  | (256) |
| Energy cost factor (ECF)         |                                  | 0.8505  | (257) |
| SAP value                        | [(255) x (256)] / [(4) + 45.0] = | 88.1359 |       |
| SAP rating (Section 12)          |                                  | 88      | (258) |
| SAP band                         |                                  | B       |       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

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

|                                       | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1         | 2187.9088          | 0.2160                        | 472.5883 (261)           |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)            | 1034.5557          | 0.2160                        | 223.4640 (264)           |
| Space and water heating               |                    |                               | 696.0523 (265)           |
| Pumps and fans                        | 216.0312           | 0.5190                        | 112.1202 (267)           |
| Energy for lighting                   | 319.7904           | 0.5190                        | 165.9712 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -526.9436          | 0.5190                        | -273.4837 (269)          |
| Total kg/year                         |                    |                               | 700.6601 (272)           |
| CO2 emissions per m2                  |                    |                               | 9.9800 (273)             |
| EI value                              |                    |                               | 91.8514                  |
| EI rating                             |                    |                               | 92 (274)                 |
| EI band                               |                    |                               | A                        |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 35.1100 (1b)              | x 2.3900 (2b)                   | = 83.9129 (1b) - (3b)       |
| First floor                                            | 35.1100 (1c)              | x 2.6700 (2c)                   | = 93.7437 (1c) - (3c)       |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.2200                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 177.6566 (5)              |

#### 2. Ventilation rate

|                                                                         | main<br>heating | secondary<br>heating | other                     | total | m <sup>3</sup> per hour   |
|-------------------------------------------------------------------------|-----------------|----------------------|---------------------------|-------|---------------------------|
| Number of chimneys                                                      | 0               | +                    | 0                         | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                                    | 0               | +                    | 0                         | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                                             |                 |                      |                           |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                                                 |                 |                      |                           |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                                            |                 |                      |                           |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) |                 |                      |                           |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                                           |                 |                      |                           |       | Yes                       |
| Measured/design AP50                                                    |                 |                      |                           |       | 4.1300                    |
| Infiltration rate                                                       |                 |                      |                           |       | 0.2065 (18)               |
| Number of sides sheltered                                               |                 |                      |                           |       | 1 (19)                    |
| Shelter factor                                                          |                 |                      | (20) = 1 - [0.075 x (19)] | =     | 0.9250 (20)               |
| Infiltration rate adjusted to include shelter factor                    |                 |                      | (21) = (18) x (20)        | =     | 0.1910 (21)               |

|                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|----------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed                                   | 4.7000 | 4.4000 | 4.4000 | 4.0000 | 4.1000 | 3.9000 | 3.9000 | 3.8000 | 3.8000 | 4.1000 | 4.0000 | 4.1000 (22)  |
| Wind factor                                  | 1.1750 | 1.1000 | 1.1000 | 1.0000 | 1.0250 | 0.9750 | 0.9750 | 0.9500 | 0.9500 | 1.0250 | 1.0000 | 1.0250 (22a) |
| Adj infilt rate                              | 0.2244 | 0.2101 | 0.2101 | 0.1910 | 0.1958 | 0.1862 | 0.1862 | 0.1815 | 0.1815 | 0.1958 | 0.1910 | 0.1958 (22b) |
| Mechanical extract ventilation - centralised |        |        |        |        |        |        |        |        |        |        |        |              |
| If mechanical ventilation:                   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a) |
| Effective ac                                 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Front Door                                                     |                         |                            | 2.1200                    | 1.1000                        | 2.3320       |                                      | (26)            |
| Windows (Uw = 1.20)                                            |                         |                            | 12.2400                   | 1.1450                        | 14.0153      |                                      | (27)            |
| Ground Floor                                                   |                         |                            | 35.1100                   | 0.1200                        | 4.2132       | 84.0000                              | 2949.2400 (28a) |
| Brick and Block                                                | 84.9600                 | 14.3600                    | 70.6000                   | 0.2400                        | 16.9440      | 42.2200                              | 2980.7320 (29a) |
| Pitched Roof                                                   | 35.1100                 |                            | 35.1100                   | 0.1000                        | 3.5110       | 9.1000                               | 319.5010 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 155.1800                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 41.0155                       |              |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 42.9400                   | 0.0000                        | 0.0000       | 70.0000                              | 3005.8000 (32)  |
| GF Stud                                                        |                         |                            | 60.0000                   |                               |              | 9.0000                               | 540.0000 (32c)  |
| First Floor                                                    |                         |                            | 74.5300                   |                               |              | 9.0000                               | 670.7700 (32c)  |
| Internal Floor 1                                               |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 35.1100                   |                               |              | 18.0000                              | 631.9800 (32e)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 11730.0030 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 167.0465 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.0959 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 47.1114 (37)    |

|                                                                     |                |                |                |                |                |                |                |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                |                |                |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>29.3133 | Feb<br>29.3133 | Mar<br>29.3133 | Apr<br>29.3133 | May<br>29.3133 | Jun<br>29.3133 | Jul<br>29.3133 | Aug<br>29.3133 | Sep<br>29.3133 | Oct<br>29.3133 | Nov<br>29.3133 | Dec<br>29.3133 (38) |
| Heat transfer coeff                                                 | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247        | 76.4247 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                |                |                |                |                |                |                |                | 76.4247 (39)        |
| HLP                                                                 | Jan<br>1.0884  | Feb<br>1.0884  | Mar<br>1.0884  | Apr<br>1.0884  | May<br>1.0884  | Jun<br>1.0884  | Jul<br>1.0884  | Aug<br>1.0884  | Sep<br>1.0884  | Oct<br>1.0884  | Nov<br>1.0884  | Dec<br>1.0884 (40)  |
| HLP (average)                                                       |                |                |                |                |                |                |                |                |                |                |                | 1.0884 (40)         |
| Days in month                                                       | 31             | 28             | 31             | 30             | 31             | 30             | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

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

|                                          |     |     |     |     |     |     |     |     |     |     |     |              |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     | 2.2515 (42)  |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     | 87.6720 (43) |
| Jan                                      | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |              |
| Daily hot water use                      |     |     |     |     |     |     |     |     |     |     |     |              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                                                 |          |          |          |          |           |           |           |           |          |                     |          |                 |
|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|---------------------|----------|-----------------|
| Energy conte                                                    | 96.4392  | 92.9324  | 89.4255  | 85.9186  | 82.4117   | 78.9048   | 78.9048   | 82.4117   | 85.9186  | 89.4255             | 92.9324  | 96.4392 (44)    |
| Energy content (annual)                                         | 143.0166 | 125.0832 | 129.0747 | 112.5304 | 107.9756  | 93.1748   | 86.3401   | 99.0766   | 100.2598 | 116.8432            | 127.5435 | 138.5039 (45)   |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |           |           |           |           |          | Total = Sum (45)m = |          | 1379.4225 (45)  |
|                                                                 | 21.4525  | 18.7625  | 19.3612  | 16.8796  | 16.1963   | 13.9762   | 12.9510   | 14.8615   | 15.0390  | 17.5265             | 19.1315  | 20.7756 (46)    |
| Water storage loss:                                             |          |          |          |          |           |           |           |           |          |                     |          |                 |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000              | 0.0000   | 0.0000 (56)     |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000              | 0.0000   | 0.0000 (57)     |
| Combi loss                                                      | 31.2121  | 28.1758  | 31.1694  | 30.1354  | 31.1192   | 30.0914   | 31.0795   | 31.1052   | 30.1154  | 31.1486             | 30.1769  | 31.2039 (61)    |
| Total heat required for water heating calculated for each month | 174.2288 | 153.2590 | 160.2441 | 142.6658 | 139.0948  | 123.2662  | 117.4197  | 130.1818  | 130.3752 | 147.9918            | 157.7204 | 169.7078 (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                                   |          |          |          |          |           |           |           |           |          |                     |          | 1206.0102 (H5)  |
| Overshading factor                                              |          |          |          |          |           |           |           |           |          |                     |          | 0.8000 (H6)     |
| Solar energy available                                          |          |          |          |          |           |           |           |           |          |                     |          | 2026.0972 (H7)  |
| Adjustment factor for showers                                   |          |          |          |          |           |           |           |           |          |                     |          | 1.0000 (H7a)    |
| Solar-to-load ratio                                             |          |          |          |          |           |           |           |           |          |                     |          | 1.4688 (H8)     |
| Utilisation factor                                              |          |          |          |          |           |           |           |           |          |                     |          | 0.4938 (H9)     |
| Collector performance factor                                    |          |          |          |          |           |           |           |           |          |                     |          | 0.8793 (H10)    |
| Dedicated solar storage volume                                  |          |          |          |          |           |           |           |           |          |                     |          | 75.0000 (H11)   |
| Effective solar volume                                          |          |          |          |          |           |           |           |           |          |                     |          | 75.0000 (H13)   |
| Daily hot water demand                                          |          |          |          |          |           |           |           |           |          |                     |          | 87.6720 (H14)   |
| Volume ratio Veff/V                                             |          |          |          |          |           |           |           |           |          |                     |          | 0.8555 (H15)    |
| Solar storage volume factor                                     |          |          |          |          |           |           |           |           |          |                     |          | 0.9688 (H16)    |
| Solar input                                                     | -27.8102 | -39.5493 | -68.6282 | -92.3165 | -107.2780 | -116.6874 | -110.6374 | -100.8906 | -78.9669 | -54.5791            | -32.8932 | -852.2574 (H17) |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |           |           |           |           |          |                     |          | -852.2574 (63)  |
| Output from w/h                                                 | 146.4185 | 113.7097 | 91.6159  | 50.3493  | 31.8168   | 6.5788    | 6.7822    | 29.2912   | 51.4084  | 93.4127             | 124.8272 | 147.6872 (64)   |
| Total per year (kWh/year) = Sum (64)m =                         |          |          |          |          |           |           |           |           |          |                     |          | 893.8979 (64)   |
| Heat gains from water heating, kWh/month                        | 55.3561  | 48.6341  | 50.7097  | 44.9502  | 43.6817   | 38.5035   | 36.4780   | 40.7193   | 40.8652  | 46.6375             | 49.9524  | 53.8535 (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                                                                               | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | 135.0872 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 45.2696  | 40.2081  | 32.6994  | 24.7556  | 18.5051  | 15.6228  | 16.8809  | 21.9425  | 29.4512  | 37.3950  | 43.6455  | 46.5278  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 295.2388 | 298.3024 | 290.5821 | 274.1465 | 253.3995 | 233.9002 | 220.8735 | 217.8098 | 225.5301 | 241.9658 | 262.7128 | 282.2121 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | 50.7602  | (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)                                 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | -90.0582 | (71) |
| Water heating gains (Table 5)                                                       | 74.4033  | 72.3722  | 68.1582  | 62.4309  | 58.7120  | 53.4770  | 49.0295  | 54.7302  | 56.7573  | 62.6848  | 69.3784  | 72.3838  | (72) |
| Total internal gains                                                                | 513.7010 | 509.6720 | 490.2290 | 460.1222 | 429.4058 | 401.7892 | 385.5732 | 393.2718 | 410.5278 | 440.8349 | 474.5259 | 499.9129 | (73) |

#### 6. Solar gains

| [Jan]     | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | g      | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W |      |
|-----------|------------|--------------------------------|------------------------------|--------|------------------------------------|------------------------------|------------|------|
| Northeast | 3.4300     | 14.6130                        | 0.6300                       | 0.7000 | 0.7700                             |                              | 15.3182    | (75) |
| Southwest | 7.4900     | 45.0642                        | 0.6300                       | 0.7000 | 0.7700                             |                              | 103.1538   | (79) |
| Northwest | 1.3200     | 14.6130                        | 0.6300                       | 0.7000 | 0.7700                             |                              | 5.8950     | (81) |

|             |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Solar gains | 124.3670 | 186.5151 | 276.7759 | 372.9316 | 417.4858 | 470.3403 | 431.0043 | 392.9134 | 323.7827 | 227.2687 | 149.7944 | 99.9469  | (83) |
| Total gains | 638.0680 | 696.1871 | 767.0049 | 833.0538 | 846.8916 | 872.1295 | 816.5776 | 786.1852 | 734.3106 | 668.1036 | 624.3204 | 599.8598 | (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                                                                         | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345 | 42.6345                   | 42.6345 | 42.6345 | 42.6345 |              |
| alpha                                                                       | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423  | 3.8423                    | 3.8423  | 3.8423  | 3.8423  |              |
| util living area                                                            | 0.9541  | 0.9365  | 0.8903  | 0.7935  | 0.6437  | 0.4355  | 0.3065  | 0.3086  | 0.5499                    | 0.8005  | 0.9209  | 0.9610  | (86)         |
| MIT                                                                         | 19.9539 | 20.0899 | 20.3717 | 20.6833 | 20.8921 | 20.9817 | 20.9965 | 20.9965 | 20.9554                   | 20.7324 | 20.3137 | 19.9085 | (87)         |
| Th 2                                                                        | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103 | 20.0103                   | 20.0103 | 20.0103 | 20.0103 | (88)         |
| util rest of house                                                          | 0.9444  | 0.9236  | 0.8683  | 0.7541  | 0.5810  | 0.3556  | 0.2158  | 0.2144  | 0.4645                    | 0.7521  | 0.9019  | 0.9525  | (89)         |
| MIT 2                                                                       | 19.0922 | 19.2228 | 19.4903 | 19.7725 | 19.9440 | 20.0030 | 20.0096 | 20.0097 | 19.9897                   | 19.8224 | 19.4415 | 19.0488 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.2224  | (91)         |
| MIT                                                                         | 19.2839 | 19.4157 | 19.6864 | 19.9751 | 20.1549 | 20.2207 | 20.2292 | 20.2292 | 20.2045                   | 20.0248 | 19.6355 | 19.2400 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.2839 | 19.4157 | 19.6864 | 19.9751 | 20.1549 | 20.2207 | 20.2292 | 20.2292 | 20.2045                   | 20.0248 | 19.6355 | 19.2400 | (93)         |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

#### 8. Space heating requirement

|                      | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec       |       |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|-----------|-------|
| Utilisation          | 0.9357    | 0.9143    | 0.8601   | 0.7526   | 0.5907   | 0.3729   | 0.2360   | 0.2354   | 0.4820   | 0.7529       | 0.8934   | 0.9443    | (94)  |
| Useful gains         | 597.0526  | 636.5420  | 659.6777 | 626.9549 | 500.2360 | 325.2474 | 192.7081 | 185.0965 | 353.9178 | 502.9967     | 557.7433 | 566.4487  | (95)  |
| Ext temp.            | 5.6000    | 6.0000    | 7.6000   | 10.1000  | 13.1000  | 15.9000  | 17.7000  | 17.8000  | 15.4000  | 12.1000      | 8.6000   | 5.7000    | (96)  |
| Heat loss rate W     | 1045.7863 | 1025.2918 | 923.6971 | 754.7047 | 539.1677 | 330.2069 | 193.2900 | 185.6506 | 367.1830 | 605.6543     | 843.3881 | 1034.7917 | (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    | 333.8579  | 261.2399  | 196.4304 | 91.9799  | 28.9652  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.3773      | 205.6643 | 348.4472  | (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 1542.9620 | (98)  |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 21.9733   | (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 %)                      |          |          |          |          |         |         |         |         |         |          |          |           | 90.7000   | (206)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |         |         |         |         |         |          |          |           | 0.0000    | (208)  |
| Space heating requirement                                             |          |          |          |          |         |         |         |         |         |          |          |           | 1701.1709 | (211)  |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec       |           |        |
| Space heating requirement                                             | 333.8579 | 261.2399 | 196.4304 | 91.9799  | 28.9652 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 76.3773  | 205.6643 | 348.4472  | (98)      |        |
| Space heating efficiency (main heating system 1)                      | 90.7000  | 90.7000  | 90.7000  | 90.7000  | 90.7000 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 90.7000  | 90.7000  | 90.7000   | (210)     |        |
| Space heating fuel (main heating system)                              | 368.0903 | 288.0264 | 216.5715 | 101.4111 | 31.9352 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 84.2087  | 226.7522 | 384.1756  | (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                                             | 146.4185 | 113.7097 | 91.6159  | 50.3493  | 31.8168 | 6.5788  | 6.7822  | 29.2912 | 51.4084 | 93.4127  | 124.8272 | 147.6872  | (64)      |        |
| Efficiency of water heater                                            | 89.5391  | 89.5451  | 89.4895  | 89.3557  | 88.7248 | 87.0000 | 87.0000 | 87.0000 | 87.0000 | 88.6263  | 89.2661  | 89.5661   | (216)     |        |
| (217)m                                                                | 89.5391  | 89.5451  | 89.4895  | 89.3557  | 88.7248 | 87.0000 | 87.0000 | 87.0000 | 87.0000 | 88.6263  | 89.2661  | 89.5661   | (217)     |        |
| Fuel for water heating, kWh/month                                     | 163.5247 | 126.9860 | 102.3761 | 56.3471  | 35.8601 | 7.5618  | 7.7957  | 33.6680 | 59.0901 | 105.4007 | 139.8371 | 164.8919  | (219)     |        |
| Water heating fuel used                                               |          |          |          |          |         |         |         |         |         |          |          | 1003.3392 | (219)     |        |
| Annual totals kWh/year                                                |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| Space heating fuel - main system                                      |          |          |          |          |         |         |         |         |         |          |          | 1701.1709 | (211)     |        |
| Space heating fuel - secondary                                        |          |          |          |          |         |         |         |         |         |          |          | 0.0000    | (215)     |        |
| Electricity for pumps and fans:                                       |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| (MEV)Centralised, Database: in-use factor = 1.4000, SFP = 0.4200)     |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| mechanical ventilation fans (SFP = 0.4200)                            |          |          |          |          |         |         |         |         |         |          |          |           | 91.0312   | (230a) |
| central heating pump                                                  |          |          |          |          |         |         |         |         |         |          |          |           | 30.0000   | (230c) |
| main heating flue fan                                                 |          |          |          |          |         |         |         |         |         |          |          |           | 45.0000   | (230e) |
| pump for solar water heating                                          |          |          |          |          |         |         |         |         |         |          |          |           | 50.0000   | (230g) |
| Total electricity for the above, kWh/year                             |          |          |          |          |         |         |         |         |         |          |          |           | 216.0312  | (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |         |         |         |         |         |          |          |           | 319.7904  | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |         |         |         |         |         |          |          |           |           |        |
| PV Unit 0 (0.80 * 0.64 * 1154 * 1.00) =                               |          |          |          |          |         |         |         |         |         |          |          |           | -591.0819 | (233)  |
| Total delivered energy for all uses                                   |          |          |          |          |         |         |         |         |         |          |          |           | 2649.2499 | (238)  |

#### 10a. Fuel costs - using BEDF prices (491)

|                                       | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |       |
|---------------------------------------|---------------|------------------|------------------|-------|
| Space heating - main system 1         | 1701.1709     | 3.6300           | 61.7525          | (240) |
| Space heating - secondary             | 0.0000        | 0.0000           | 0.0000           | (242) |
| Water heating (other fuel)            | 1003.3392     | 3.6300           | 36.4212          | (247) |
| Mechanical ventilation fans           | 91.0312       | 19.4400          | 17.6965          | (249) |
| Pumps and fans for heating            | 75.0000       | 19.4400          | 14.5800          | (249) |
| Pump for solar water heating          | 50.0000       | 19.4400          | 9.7200           | (249) |
| Energy for lighting                   | 319.7904      | 19.4400          | 62.1673          | (250) |
| Additional standing charges           |               |                  | 95.0000          | (251) |
| Energy saving/generation technologies |               |                  |                  |       |
| PV Unit                               | -591.0819     | 19.4400          | -114.9063        | (252) |
| Total energy cost                     |               |                  | 182.4311         | (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 | 1701.1709       | 0.2160                     | 367.4529              | (261) |
| Space heating - secondary     | 0.0000          | 0.0000                     | 0.0000                | (263) |
| Water heating (other fuel)    | 1003.3392       | 0.2160                     | 216.7213              | (264) |
| Space and water heating       |                 |                            | 584.1742              | (265) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Built)

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

|                                       |           |        |                 |
|---------------------------------------|-----------|--------|-----------------|
| Pumps and fans                        | 216.0312  | 0.5190 | 112.1202 (267)  |
| Energy for lighting                   | 319.7904  | 0.5190 | 165.9712 (268)  |
| Energy saving/generation technologies |           |        |                 |
| PV Unit                               | -591.0819 | 0.5190 | -306.7715 (269) |
| Total kg/year                         |           |        | 555.4941 (272)  |

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

|                                       | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1         | 1701.1709          | 1.2200                              | 2075.4285 (261)            |
| Space heating - secondary             | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)            | 1003.3392          | 1.2200                              | 1224.0738 (264)            |
| Space and water heating               |                    |                                     | 3299.5023 (265)            |
| Pumps and fans                        | 216.0312           | 3.0700                              | 663.2159 (267)             |
| Energy for lighting                   | 319.7904           | 3.0700                              | 981.7567 (268)             |
| Energy saving/generation technologies |                    |                                     |                            |
| PV Unit                               | -591.0819          | 3.0700                              | -1814.6214 (269)           |
| Primary energy kWh/year               |                    |                                     | 3129.8535 (272)            |
| Primary energy kWh/m2/year            |                    |                                     | 44.5721 (273)              |

# U-VALUE CALCULATOR REPORT

|                      |                                                    |                |            |
|----------------------|----------------------------------------------------|----------------|------------|
| Property Reference   | SAP 0647 Plot 80                                   | Issued on Date | 22/03/2022 |
| Assessment Reference | As Built                                           | Prop Type Ref  | D (HA/AR)  |
| Project              | 7 Haines Crescent, West End, Southampton, SO30 3LG |                |            |
| Calculation Type     | New Build (As Built)                               |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 87 B | DER         | 14.28 | TER  | 19.26 |
| Environmental                      | 90 B | % DER<TER   | 25.84 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.74 | DFEE        | 43.45 | TREE | 53.61 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 18.96 |      |       |

|                  |                                                                                          |             |           |
|------------------|------------------------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com | Assessor ID | E477-0001 |
| Client           | Foreman Homes, FORE                                                                      |             |           |

## Building Elements

### Roof 000002 - Mineral Wool between and above

Roof Type: Pitched Roof, insulated flat ceiling

| Layer       | Description                                                | Thickness (mm) | Conductivity (W/m <sup>2</sup> K) | Resistance (m <sup>2</sup> K/W) | Fraction (%) | Density (kg/m <sup>3</sup> ) | Heat Cap. (J/kgK) |
|-------------|------------------------------------------------------------|----------------|-----------------------------------|---------------------------------|--------------|------------------------------|-------------------|
| Ext surface |                                                            |                |                                   | 0.0400                          |              |                              |                   |
| Layer 1     | <b>Earthwool Loft Roll 40</b>                              |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 150            | 0.0400                            | 3.7500                          | 100.00       |                              |                   |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                |                                   |                                 |              |                              |                   |
| Layer 2     | <b>Earthwool Loft Roll 40</b>                              |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 200            | 0.0400                            | 5.0000                          | 100.00       |                              |                   |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                |                                   |                                 |              |                              |                   |
| Layer 3     | <b>Earthwool Loft Roll 40</b>                              |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 100            | 0.0400                            | 2.5000                          | 87.50        |                              |                   |
|             | Main construction                                          | 100            | 0.1300                            | 0.7692                          | 12.50        |                              |                   |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                |                                   |                                 |              |                              |                   |
| Layer 4     | <b>Plasterboard, standard</b>                              |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 12.5           | 0.2100                            | 0.0595                          | 100.00       | 700                          | 1000              |
| Int surface |                                                            |                |                                   | 0.1000                          |              |                              |                   |

|                   |                                              |                                              |                                     |
|-------------------|----------------------------------------------|----------------------------------------------|-------------------------------------|
| Total resistance: | Upper limit = 11.200 m <sup>2</sup> K/W      | Lower limit = 10.901 m <sup>2</sup> K/W      | Average = 11.050 m <sup>2</sup> K/W |
|                   | Total correction = 0.0065 m <sup>2</sup> K/W | U-value (unrounded) = 0.1 W/m <sup>2</sup> K |                                     |

Unheated space: None

Total thickness: 463 mm

U-value: 0.10 W/m<sup>2</sup> K

Kappa: 9.10 kJ/m<sup>2</sup> K

# U-VALUE CALCULATOR REPORT

|                      |                                                    |                |            |
|----------------------|----------------------------------------------------|----------------|------------|
| Property Reference   | SAP 0647 Plot 80                                   | Issued on Date | 22/03/2022 |
| Assessment Reference | As Built                                           | Prop Type Ref  | D (HA/AR)  |
| Project              | 7 Haines Crescent, West End, Southampton, SO30 3LG |                |            |
| Calculation Type     | New Build (As Built)                               |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 87 B | DER         | 14.28 | TER  | 19.26 |
| Environmental                      | 90 B | % DER<TER   | 25.84 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.74 | DFEE        | 43.45 | TFEE | 53.61 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 18.96 |      |       |

|                  |                                                                                          |             |           |
|------------------|------------------------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com | Assessor ID | E477-0001 |
|------------------|------------------------------------------------------------------------------------------|-------------|-----------|

|        |                     |
|--------|---------------------|
| Client | Foreman Homes, FORE |
|--------|---------------------|

## Building Elements

### Wall 000001

#### Wall Type: Standard Wall

| Layer       | Description                                                | Thickness (mm) | Conductivity (W/m <sup>2</sup> K) | Resistance (m <sup>2</sup> K/W) | Fraction (%) | Density (kg/m <sup>3</sup> ) | Heat Cap. (J/kgK) |
|-------------|------------------------------------------------------------|----------------|-----------------------------------|---------------------------------|--------------|------------------------------|-------------------|
| Ext surface |                                                            |                |                                   | 0.0400                          |              |                              |                   |
| Layer 1     | <b>Brick, outer leaf</b>                                   |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 102            | 0.7700                            | 0.1325                          | 82.81        |                              |                   |
|             | Main construction                                          | 102            | 0.9407                            | 0.1084                          | 17.19        |                              |                   |
| Layer 2     | <b>Supafil 34</b>                                          |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 100            | 0.0340                            | 2.9412                          | 100.00       |                              |                   |
|             | Corrections - Air Gap: Level 0, Fasteners: None or plastic |                |                                   |                                 |              |                              |                   |
| Layer 3     | <b>Supabloc</b>                                            |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 100            | 0.1100                            | 0.9091                          | 94.04        | 460                          | 1000              |
|             | Main construction                                          | 100            | 0.8803                            | 0.1136                          | 5.96         | 460                          | 1000              |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                |                                   |                                 |              |                              |                   |
| Layer 4     | <b>airspace/plaster dabs</b>                               |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 15             | 0.0882                            | 0.1700                          | 80.00        |                              |                   |
|             | Main construction                                          | 15             | 0.0882                            | 0.1700                          | 20.00        |                              |                   |
|             | Corrections - Cavity Unventilated, Emissivity: Normal      |                |                                   |                                 |              |                              |                   |
| Layer 5     | <b>Plasterboard, standard</b>                              |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 12.5           | 0.2100                            | 0.0595                          | 100.00       | 700                          | 1000              |
| Int surface |                                                            |                |                                   | 0.1300                          |              |                              |                   |

|                   |                                              |                                               |                                    |
|-------------------|----------------------------------------------|-----------------------------------------------|------------------------------------|
| Total resistance: | Upper limit = 4.321 m <sup>2</sup> K/W       | Lower limit = 4.110 m <sup>2</sup> K/W        | Average = 4.215 m <sup>2</sup> K/W |
|                   | Total correction = 0.0002 m <sup>2</sup> K/W | U-value (unrounded) = 0.24 W/m <sup>2</sup> K |                                    |

Unheated space: None

Total thickness: 330 mm

U-value: 0.24 W/m<sup>2</sup> K

Kappa: 42.22 kJ/m<sup>2</sup> K

# U-VALUE CALCULATOR REPORT

|                      |                                                    |                |            |
|----------------------|----------------------------------------------------|----------------|------------|
| Property Reference   | SAP 0647 Plot 80                                   | Issued on Date | 22/03/2022 |
| Assessment Reference | As Built                                           | Prop Type Ref  | D (HA/AR)  |
| Project              | 7 Haines Crescent, West End, Southampton, SO30 3LG |                |            |
| Calculation Type     | New Build (As Built)                               |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 87 B | DER         | 14.28 | TER  | 19.26 |
| Environmental                      | 90 B | % DER<TER   | 25.84 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.74 | DFEE        | 43.45 | TFEE | 53.61 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 18.96 |      |       |

|                  |                                                                                          |             |           |
|------------------|------------------------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com | Assessor ID | E477-0001 |
|------------------|------------------------------------------------------------------------------------------|-------------|-----------|

|        |                     |
|--------|---------------------|
| Client | Foreman Homes, FORE |
|--------|---------------------|

## Building Elements

### Floor 000003 - Worst Case Slab

Floor Type: Slab On Ground Floor

Area = 35.11 m<sup>2</sup>, Perimeter = 16.79 m, Wall thickness = 275.00 mm, Soil: Unknown

Horizontal edge insulation: none

Vertical edge insulation: none

| Layer       | Description                                                | Thickness (mm) | Conductivity (W/m <sup>2</sup> K) | Resistance (m <sup>2</sup> K/W) | Fraction (%) | Density (kg/m <sup>3</sup> ) | Heat Cap. (J/kgK) |
|-------------|------------------------------------------------------------|----------------|-----------------------------------|---------------------------------|--------------|------------------------------|-------------------|
| Ext surface |                                                            |                |                                   | 0.0400                          |              |                              |                   |
| Layer 1     | <b>Concrete, medium density</b>                            |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 100            | 1.3500                            | 0.0741                          | 100.00       |                              |                   |
| Layer 2     | <b>Polythene, 1000 gauge</b>                               |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 0.5            | 0.0000                            | 0.0000                          | 100.00       |                              |                   |
| Layer 3     | <b>Celotex XR4000</b>                                      |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 150            | 0.0220                            | 6.8182                          | 100.00       |                              |                   |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                |                                   |                                 |              |                              |                   |
| Layer 4     | <b>Polythene, 500 gauge</b>                                |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 0.5            | 0.0000                            | 0.0000                          | 100.00       |                              |                   |
| Layer 5     | <b>Screed</b>                                              |                |                                   |                                 |              |                              |                   |
|             | Main construction                                          | 70             | 1.1500                            | 0.0609                          | 100.00       | 1200                         | 1000              |
| Int surface |                                                            |                |                                   | 0.1700                          |              |                              |                   |

Total resistance: Upper limit = 6.953 m<sup>2</sup> K/W Lower limit = 6.953 m<sup>2</sup> K/W Average = 6.953 m<sup>2</sup> K/W

Total correction = 0.0096 m<sup>2</sup> K/W

U-value (unrounded) = 0.12 W/m<sup>2</sup> K

Unheated space: None

Total thickness: 321 mm

U-value: 0.12 W/m<sup>2</sup> K

Kappa: 84.00 kJ/m<sup>2</sup> K

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

|                                    |                                                                                          |                |             |
|------------------------------------|------------------------------------------------------------------------------------------|----------------|-------------|
| Property Reference                 | SAP 0647 Plot 80                                                                         | Issued on Date | 22/03/2022  |
| Assessment Reference               | As Built                                                                                 | Prop Type Ref  | D (HA/AR)   |
| Property                           | 7 Haines Crescent, West End, Southampton, SO30 3LG                                       |                |             |
| SAP Rating                         | 87 B                                                                                     | DER            | 14.28       |
| Environmental                      | 90 B                                                                                     | TER            | 19.26       |
| CO <sub>2</sub> Emissions (t/year) | 0.74                                                                                     | % DER<TER      | 25.84       |
| General Requirements Compliance    | Pass                                                                                     | DLEE           | 43.45       |
|                                    |                                                                                          | TFEE           | 53.61       |
|                                    |                                                                                          | % DLEE<TFEE    | 18.96       |
| Assessor Details                   | Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 01329 313079, tobiaswhiting26@gmail.com |                | Assessor ID |
|                                    |                                                                                          |                | E477-0001   |
| Client                             | Foreman Homes, FORE                                                                      |                |             |

### SUMMARY FOR INPUT DATA FOR: New Build (As Built)

|                       |                      |
|-----------------------|----------------------|
| Orientation           | North East           |
| Property Tenure       | Unknown              |
| Transaction Type      | New dwelling         |
| Terrain Type          | Suburban             |
| 1.0 Property Type     | House, Semi-Detached |
| 2.0 Number of Storeys | 2                    |
| 3.0 Date Built        | 2020                 |
| 4.0 Sheltered Sides   | 1                    |
| 5.0 Sunlight/Shade    | Average or unknown   |

|                  |               |                     |                      |                       |
|------------------|---------------|---------------------|----------------------|-----------------------|
| 6.0 Measurements |               | Heat Loss Perimeter | Internal Floor Area  | Average Storey Height |
|                  | Ground Floor: | 16.79 m             | 35.11 m <sup>2</sup> | 2.39 m                |
|                  | 1st Storey:   | 16.79 m             | 35.11 m <sup>2</sup> | 2.67 m                |

|                            |                     |                     |
|----------------------------|---------------------|---------------------|
| 7.0 Living Area            | 15.62               | m <sup>2</sup>      |
| 8.0 Thermal Mass Parameter | Precise calculation |                     |
| Thermal Mass               | 167.05              | kJ/m <sup>2</sup> K |

| 9.0 External Walls |             |              | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Gross Area (m <sup>2</sup> ) | Nett Area (m <sup>2</sup> ) |
|--------------------|-------------|--------------|------------------------------|-----------------------------|------------------------------|-----------------------------|
| Description        | Type        | Construction |                              |                             |                              |                             |
| Brick and Block    | Cavity Wall | Other        | 0.24                         | 42.22                       | 84.96                        | 70.60                       |

| 9.1 Party Walls |                                 |                                                                                | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Area (m <sup>2</sup> ) |
|-----------------|---------------------------------|--------------------------------------------------------------------------------|------------------------------|-----------------------------|------------------------|
| Description     | Type                            | Construction                                                                   |                              |                             |                        |
| Party Wall 1    | Filled Cavity with Edge Sealing | Single plasterboard on dabs on both sides, dense blocks, cavity or cavity fill | 0.00                         | 70.00                       | 42.94                  |

| 9.2 Internal Walls |                              |  | Kappa (kJ/m <sup>2</sup> K) | Area (m <sup>2</sup> ) |
|--------------------|------------------------------|--|-----------------------------|------------------------|
| Description        | Construction                 |  |                             |                        |
| GF Stud            | Plasterboard on timber frame |  | 9.00                        | 60.00                  |
| First Floor        | Plasterboard on timber frame |  | 9.00                        | 74.53                  |

| 10.0 External Roofs |                     |              | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Gross Area (m <sup>2</sup> ) | Nett Area (m <sup>2</sup> ) |
|---------------------|---------------------|--------------|------------------------------|-----------------------------|------------------------------|-----------------------------|
| Description         | Type                | Construction |                              |                             |                              |                             |
| Pitched Roof        | External Plane Roof | Other        | 0.10                         | 9.10                        | 35.11                        | 35.11                       |

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

### 10.2 Internal Ceilings

| Description        | Construction                                   | Kappa (kJ/m²K) | Area (m²) |
|--------------------|------------------------------------------------|----------------|-----------|
| Internal Ceiling 1 | Plasterboard ceiling, carpeted chipboard floor | 9.00           | 35.11     |

### 11.0 Heat Loss Floors

| Description  | Type                 | Construction | U-Value (W/m²K) | Kappa (kJ/m²K) | Area (m²) |
|--------------|----------------------|--------------|-----------------|----------------|-----------|
| Ground Floor | Ground Floor - Solid | Other        | 0.12            | 84.00          | 35.11     |

### 11.2 Internal Floors

| Description      | Construction                                   | Kappa (kJ/m²K) | Area (m²) |
|------------------|------------------------------------------------|----------------|-----------|
| Internal Floor 1 | Plasterboard ceiling, carpeted chipboard floor | 18.00          | 35.11     |

### 12.0 Opening Types

| Description | Data Source  | Type       | Glazing               | Glazing Gap | Argon Filled | G-value | Frame Type | Frame Factor | U Value (W/m²K) |
|-------------|--------------|------------|-----------------------|-------------|--------------|---------|------------|--------------|-----------------|
| Front Door  | Manufacturer | Solid Door |                       |             |              |         |            |              | 1.10            |
| Windows     | Manufacturer | Window     | Double Low-E Soft 0.1 |             |              | 0.63    |            | 0.70         | 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] Brick and Block | North East  |              |                |               |           |            |       | 2.12      |                |
| Front Elevation | Window       | [1] Brick and Block | North East  | None         | 0.00           |               |           |            |       | 3.43      |                |
| Side Elevation  | Window       | [1] Brick and Block | North West  | None         | 0.00           |               |           |            |       | 1.32      |                |
| Rear Elevation  | Window       | [1] Brick and Block | South West  | None         | 0.00           |               |           |            |       | 7.49      |                |

### 14.0 Conservatory

None

### 15.0 Draught Proofing

100 %

### 16.0 Draught Lobby

No

### 17.0 Thermal Bridging

Calculate Bridges

### 17.1 List of Bridges

| Source Type            | Bridge Type                                          | Length | Psi   | Imported | Reference:        |
|------------------------|------------------------------------------------------|--------|-------|----------|-------------------|
| Independently assessed | E2 Other lintels (including other steel lintels)     | 1.26   | 0.077 | No       | Birtley Supatherm |
| Independently assessed | E2 Other lintels (including other steel lintels)     | 2.75   | 0.070 | No       | Birtley Supatherm |
| Independently assessed | E2 Other lintels (including other steel lintels)     | 1.01   | 0.071 | No       | Birtley Supatherm |
| Independently assessed | E2 Other lintels (including other steel lintels)     | 3.60   | 0.067 | No       | Birtley Supatherm |
| Independently assessed | E2 Other lintels (including other steel lintels)     | 1.51   | 0.070 | No       | Birtley Supatherm |
| Independently assessed | E3 Sill                                              | 7.61   | 0.021 | No       | Knauf P5          |
| Independently assessed | E4 Jamb                                              | 27.30  | 0.016 | No       | Knauf P6          |
| Independently assessed | E5 Ground floor (normal)                             | 16.79  | 0.060 | No       | CBA - 302         |
| Independently assessed | E6 Intermediate floor within a dwelling              | 16.79  | 0.000 | No       | CD0029            |
| Table K1 - Approved    | E10 Eaves (insulation at ceiling level)              | 16.79  | 0.060 | No       |                   |
| Independently assessed | E16 Corner (normal)                                  | 10.10  | 0.039 | No       | Knauf P23         |
| Table K1 - Approved    | E18 Party wall between dwellings                     | 10.10  | 0.060 | No       |                   |
| Table K1 - Default     | P1 Party wall - Ground floor                         | 8.50   | 0.160 | No       |                   |
| Table K1 - Default     | P2 Party wall - Intermediate floor within a dwelling | 8.50   | 0.000 | No       |                   |
| Independently assessed | P4 Party wall - Roof (insulation at ceiling level)   | 8.50   | 0.049 | No       | CD0020            |

Y-value 0.039 W/m²K

### 18.0 Pressure Testing

|                           |      |                   |
|---------------------------|------|-------------------|
| Designed AP <sub>50</sub> | Yes  |                   |
| Property Tested ?         | 5.00 | m³/(h.m²) @ 50 Pa |
| As Built AP <sub>50</sub> | Yes  |                   |
|                           | 4.13 | m³/(h.m²) @ 50 Pa |

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

### 19.0 Mechanical Ventilation

#### Summer Overheating

|                             |                   |
|-----------------------------|-------------------|
| Windows open in hot weather | Windows half open |
| Cross ventilation possible  | Yes               |
| Night Ventilation           | Yes               |
| Air change rate             | 4.00              |

#### Mechanical Ventilation

|                                       |                                              |
|---------------------------------------|----------------------------------------------|
| Mechanical Ventilation System Present | Yes                                          |
| Approved Installation                 | No                                           |
| Mechanical Ventilation data Type      | Database                                     |
| Type                                  | Mechanical extract ventilation - centralised |
| MV Reference Number                   | 500233                                       |
| Configuration                         | 2                                            |
| Manufacturer SFP                      | 0.30                                         |
| Duct Type                             | Rigid                                        |
| Wet Rooms                             | 2                                            |

### 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  |     |     |       | 0     |
| Number of passive vents      |     |     |       | 0     |
| Number of flueless gas fires |     |     |       | 0     |

### 21.0 Fixed Cooling System

No

### 22.0 Lighting

#### Internal

|                                 |        |   |
|---------------------------------|--------|---|
| Total number of light fittings  | 13     |   |
| Total number of L.E.L. fittings | 13     |   |
| Percentage of L.E.L. fittings   | 100.00 | % |

#### External

|                         |     |
|-------------------------|-----|
| External lights fitted  | Yes |
| Light and motion sensor | Yes |

### 23.0 Electricity Tariff

Standard

### 24.0 Main Heating 1

|                    |                                          |   |
|--------------------|------------------------------------------|---|
| Description        | Database                                 |   |
| Percentage of Heat | Gas Combi                                | % |
| Database Ref. No.  | 100                                      |   |
| Fuel Type          | 17503                                    |   |
| Main Heating       | Mains gas                                |   |
| SAP Code           | BGW                                      |   |
| In Winter          | 104                                      |   |
| In Summer          | 90.7                                     |   |
| Controls           | 87.0                                     |   |
| PCDF Controls      | CBE Programmer, room thermostat and TRVs |   |
| Delayed Start Stat | 0                                        |   |
| Sap Code           | No                                       |   |
| Flue Type          | 2106                                     |   |
|                    | Balanced                                 |   |

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Built)

|                            |                      |
|----------------------------|----------------------|
| Fan Assisted Flue          | Yes                  |
| Is MHS Pumped              | Pump in heated space |
| Heat Emitter               | Radiators            |
| Flow Temperature           | Normal (> 45°C)      |
| Combi boiler type          | Standard Combi       |
| Combi keep hot type        | Gas/Oil, time clock  |
| <b>25.0 Main Heating 2</b> | None                 |

|                                                  |                         |
|--------------------------------------------------|-------------------------|
| Community Heating                                | None                    |
| <b>28.0 Water Heating</b>                        | 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                     |

|                                |      |
|--------------------------------|------|
| <b>29.0 Hot Water Cylinder</b> | None |
|--------------------------------|------|

|                               |                    |                  |                    |                              |
|-------------------------------|--------------------|------------------|--------------------|------------------------------|
| <b>32.0 Photovoltaic Unit</b> | One Dwelling       |                  |                    |                              |
| <b>PV Cells kWp</b>           | <b>Orientation</b> | <b>Elevation</b> | <b>Overshading</b> | <b>Connected to Dwelling</b> |
| 0.64                          | South West         | 30°              | None Or Little     | Yes                          |

### 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 | £26                      | B 88                      |                      |