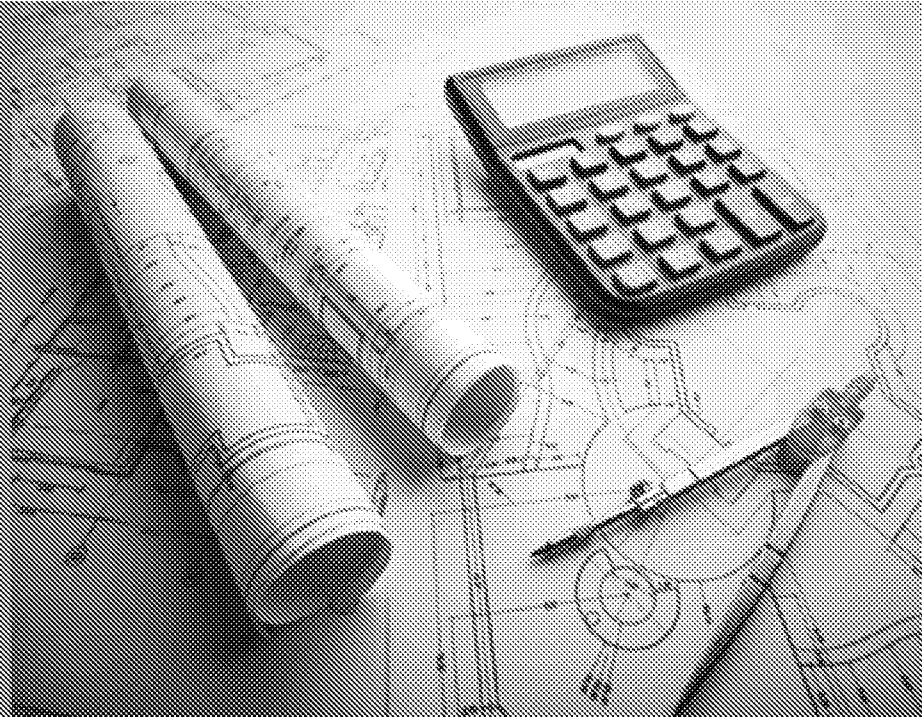




## SAP Report Submission for Building Regulations Compliance

Client: Vivid Design Studio

Project: Plot 5, 15-17, Kew Gardens  
Bognor Regis, West Sussex, PO21 5RD

Contact: Mark Rogers  
Surecalc Limited



Report Issue Date: 17/01/2020

EXCELLENCE  
IN ENERGY  
ASSESSMENT

# CODE FOR SUSTAINABLE HOMES

## Calculation Type: New Build (As Designed)



|                      |                                                                 |                |              |
|----------------------|-----------------------------------------------------------------|----------------|--------------|
| Property Reference   | sc120972                                                        | Issued on Date | 17/01/2020   |
| Assessment Reference | 001                                                             | Prop Type Ref  | New Dwelling |
| Property             | Plot 5, 15-17, Kew Gardens, Bognor Regis, West Sussex, PO21 5RD |                |              |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 87 B | DER         | 14.41 | TER  | 18.33 |
| Environmental                      | 89 B | % DER<TER   | 21.38 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.84 | DFEE        | 44.93 | TFEE | 53.01 |
| General Requirements Compliance    | Pass | % DFEE<TFEE | 15.24 |      |       |

|                  |                                   |             |           |
|------------------|-----------------------------------|-------------|-----------|
| Assessor Details | Mr. Mark Rogers, Surecalc Limited | Assessor ID | A320-0001 |
|------------------|-----------------------------------|-------------|-----------|

|        |                                          |
|--------|------------------------------------------|
| Client | Vivid Design Studio, Vivid Design Studio |
|--------|------------------------------------------|

### ENE 1 - Dwelling Emission Rate calculation

|                                                                                   |       |                                            |
|-----------------------------------------------------------------------------------|-------|--------------------------------------------|
| Total floor area                                                                  | 85.4  | m <sup>2</sup>                             |
| DER                                                                               | 14.41 | kgCO <sub>2</sub> /yr/m <sup>2</sup>       |
| TER                                                                               | 18.33 | kgCO <sub>2</sub> /yr/m <sup>2</sup>       |
| CO <sub>2</sub> emissions offset from additional allowable electricity generation | 0.00  | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC7) |
| Residual CO <sub>2</sub> emissions offset from biofuel CHP                        | 0.00  | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC5) |
| Total CO <sub>2</sub> emissions offset from SAP Section 16 allowances             | 0.00  | kgCO <sub>2</sub> /yr/m <sup>2</sup>       |
| DER accounting for SAP Section 16 allowances                                      | 14.41 | kgCO <sub>2</sub> /yr/m <sup>2</sup>       |
| Reduction DER/TER                                                                 | 21.38 | %                                          |
| CfSH ENE1 credits achieved                                                        | 3.1   |                                            |
| CfSH ENE1 level achieved                                                          | 4     |                                            |

### ENE 2 - Fabric Energy Efficiency calculation

|                                        |                              |
|----------------------------------------|------------------------------|
| Dwelling type                          | House, Semi-Detached         |
| Fabric energy efficiency (F.E.E.)      | 44.93 kWh/m <sup>2</sup> /yr |
| CfSH ENE2 credits achieved             | 7.2                          |
| CfSH ENE1 and 2 overall level achieved | 4                            |

### ENE 7 - Low and Zero Carbon Technologies calculation

#### Standard case CO<sub>2</sub> emissions

|                                                      |       |                                            |
|------------------------------------------------------|-------|--------------------------------------------|
| Total floor area                                     | 85.4  | m <sup>2</sup>                             |
| DER                                                  | 19.26 | kgCO <sub>2</sub> /yr/m <sup>2</sup>       |
| CO <sub>2</sub> emissions from electrical appliances | 15.98 | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC2) |
| CO <sub>2</sub> emissions from cooking               | 2.11  | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC3) |
| Standard case total CO <sub>2</sub> emissions        | 37.36 | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC4) |
| Net Standard case CO <sub>2</sub> emissions          | 37.36 | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC8) |

#### Actual case CO<sub>2</sub> emissions

|                                                                            |       |                                            |
|----------------------------------------------------------------------------|-------|--------------------------------------------|
| DER                                                                        | 15.38 | kgCO <sub>2</sub> /yr/m <sup>2</sup>       |
| CO <sub>2</sub> emissions from electrical appliances                       | 15.98 | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC2) |
| CO <sub>2</sub> emissions from cooking                                     | 2.11  | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC3) |
| Actual case total CO <sub>2</sub> emissions                                | 33.48 | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC4) |
| CO <sub>2</sub> emissions from Biomass                                     | 0.00  | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC5) |
| CO <sub>2</sub> reduction from additional allowable electricity generation | 0.00  | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC7) |
| Net Actual case CO <sub>2</sub> emissions                                  | 33.48 | kgCO <sub>2</sub> /yr/m <sup>2</sup> (ZC8) |
| Improvement in net actual/net standard case CO <sub>2</sub> emissions      | 10    | %                                          |



ENE7 credits achieved

1

# PREDICTED ENERGY ASSESSMENT

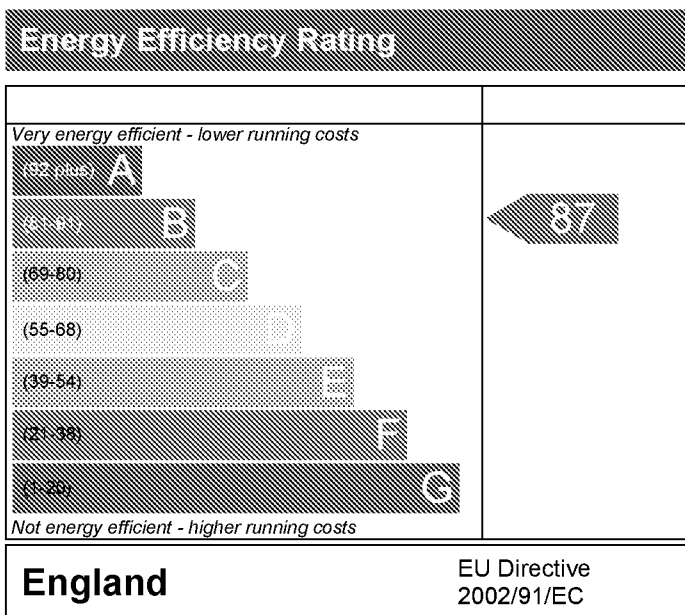
surecalc ltd

Plot 5, 15-17, Kew Gardens,  
Bognor Regis,  
West Sussex,  
PO21 5RD

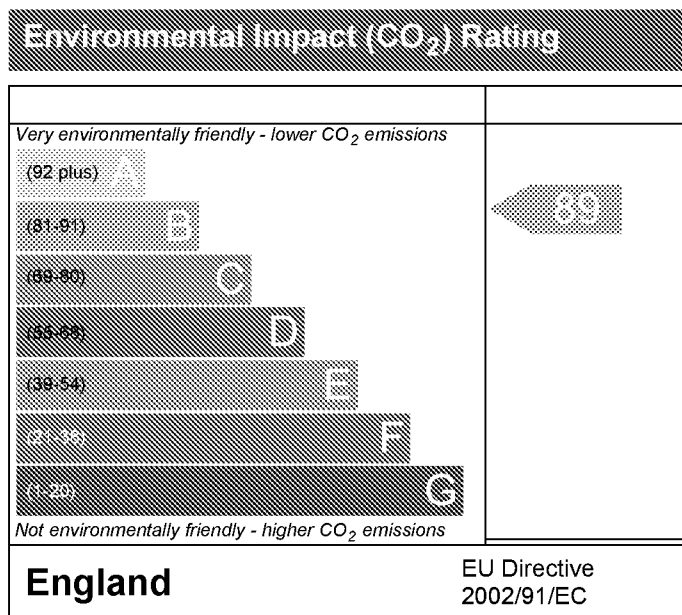
Dwelling type: House, Semi-Detached  
Date of assessment: 17/01/2020  
Produced by: Surecalc Limited  
Total floor area: 85.4 m<sup>2</sup>  
DRRN: 4290-4391-3081

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

The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



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



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

*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 Designed)



|                                    |                                                                 |                |              |
|------------------------------------|-----------------------------------------------------------------|----------------|--------------|
| Property Reference                 | sc120972                                                        | Issued on Date | 17/01/2020   |
| Assessment Reference               | 001                                                             | Prop Type Ref  | New Dwelling |
| Property                           | Plot 5, 15-17, Kew Gardens, Bognor Regis, West Sussex, PO21 5RD |                |              |
| SAP Rating                         | 87 B                                                            | DER            | 14.41        |
| Environmental                      | 89 B                                                            | % DER<TER      | 21.38        |
| CO <sub>2</sub> Emissions (t/year) | 0.84                                                            | DFEE           | 44.93        |
| General Requirements Compliance    | Pass                                                            | % DFEE<TFEE    | 15.24        |
| Assessor Details                   | Mr. Mark Rogers, Surecalc Limited, [REDACTED]                   |                | Assessor ID  |
|                                    | [REDACTED]                                                      |                | A320-0001    |
| Client                             | Vivid Design Studio, Vivid Design Studio                        |                |              |

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

#### Criterion 1 – Achieving the TER and TFEE rate

##### 1a TER and DER

|                                             |                  |                                   |      |
|---------------------------------------------|------------------|-----------------------------------|------|
| Fuel for main heating                       | Mains gas        |                                   |      |
| Fuel factor                                 | 1.00 (mains gas) |                                   |      |
| Target Carbon Dioxide Emission Rate (TER)   | 18.33            | kgCO <sub>2</sub> /m <sup>2</sup> |      |
| Dwelling Carbon Dioxide Emission Rate (DER) | 14.41            | kgCO <sub>2</sub> /m <sup>2</sup> | Pass |
|                                             | -3.92 (-21.4%)   | kgCO <sub>2</sub> /m <sup>2</sup> |      |

##### 1b TFEE and DFEE

|                                          |               |                        |      |
|------------------------------------------|---------------|------------------------|------|
| Target Fabric Energy Efficiency (TFEE)   | 53.01         | kWh/m <sup>2</sup> /yr |      |
| Dwelling Fabric Energy Efficiency (DFEE) | 44.93         | kWh/m <sup>2</sup> /yr |      |
|                                          | -8.1 (-15.3%) | 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         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | Pass |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | Pass |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | Pass |

##### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

##### 3 Air permeability

|                                |                     |                                             |      |
|--------------------------------|---------------------|---------------------------------------------|------|
| Air permeability at 50 pascals | 5.00 (design value) | 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

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# BUILDING REGULATION COMPLIANCE

## Calculation Type: New Build (As Designed)



Main heating system

Boiler system with radiators or underfloor - Mains gas  
Data from database  
Glow-worm ULTIMATE 3 30c-A (H-GB)  
Combi boiler  
Efficiency: 89.6% SEDBUK2009  
Minimum: 88.0%

Pass

Secondary heating system

None

### 5 Cylinder insulation

Hot water storage

No cylinder

### 6 Controls

Space heating controls

Time and temperature zone control

Pass

Hot water controls

No cylinder

Boiler interlock

Yes

Pass

### 7 Low energy lights

Percentage of fixed lights with low-energy fittings

100

%

Minimum

75

%

Pass

### 8 Mechanical ventilation

Not applicable

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

### 9 Summertime temperature

Overheating risk (Southern England)

Slight

Pass

Based on:

Overshading

Average

Windows facing East

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

Windows facing South

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

Windows facing West

7.26 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

5.00 (design value)

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

### 10 Key features

Party wall U-value

0.00

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

Roof U-value

0.11

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

Floor U-value

0.11

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

Thermal bridging y-value

0.032

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

Photovoltaic array

1.10

kW

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



|                                    |                                                                 |               |              |                |            |
|------------------------------------|-----------------------------------------------------------------|---------------|--------------|----------------|------------|
| Property Reference                 | sc120972                                                        |               |              | Issued on Date | 17/01/2020 |
| Assessment Reference               | 001                                                             | Prop Type Ref | New Dwelling |                |            |
| Property                           | Plot 5, 15-17, Kew Gardens, Bognor Regis, West Sussex, PO21 5RD |               |              |                |            |
| SAP Rating                         | 87 B                                                            | DER           | 14.41        | TER            | 18.33      |
| Environmental                      | 89 B                                                            | % DER<TER     | 21.38        |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.84                                                            | DEEE          | 44.93        | TTEE           | 53.01      |
| General Requirements Compliance    | Pass                                                            | % DEEE<TTEE   | 15.24        |                |            |
| Assessor Details                   | Mr. Mark Rogers, Surecalc Limited, [REDACTED]                   |               |              | Assessor ID    | A320-0001  |
| Client                             | Vivid Design Studio, Vivid Design Studio                        |               |              |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

#### DWELLING AS DESIGNED

Semi-Detached House, total floor area 85 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) 18.33 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.41 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)44.9 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         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

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

#### 4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas  
Data from database  
Glow-worm ULTIMATE 3 30c-A (H-GB)  
Combi boiler  
Efficiency: 89.6% SEDBUK2009  
Minimum: 88.0% OK

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage No cylinder

#### 6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

#### 7 Low energy lights

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

#### 8 Mechanical ventilation

Not applicable

#### 9 Summertime temperature

Overheating risk (Southern England): Slight OK  
Based on:  
Overshading: Average  
Windows facing East: 4.07 m<sup>2</sup>, No overhang  
Windows facing South: 1.80 m<sup>2</sup>, No overhang  
Windows facing West: 7.26 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 0.11 W/m<sup>2</sup>K  
Floor U-value 0.11 W/m<sup>2</sup>K  
Thermal bridging y-value 0.032 W/m<sup>2</sup>K  
Photovoltaic array 1.10 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                   | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                   | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 219.9050 (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                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (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) = |                 |                      |       |                             | 40.0000 / (5) = 0.1819 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.4319 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3671 (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 | 0.4681 | 0.4589 | 0.4497 | 0.4038 | 0.3946 | 0.3488 | 0.3488 | 0.3396 | 0.3671 | 0.3946 | 0.4130 | 0.4314 (22b) |
| Effective ac    | 0.6095 | 0.6053 | 0.6011 | 0.5615 | 0.5779 | 0.5608 | 0.5608 | 0.5577 | 0.5674 | 0.5779 | 0.5853 | 0.5930 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 44.2338  | 43.9251  | 43.6225 | 42.2013 | 41.9354 | 40.6976 | 40.6976 | 40.4684 | 41.1744 | 41.9354 | 42.4733 | 43.0357 (38) |
| Heat transfer coeff       | 100.4527 | 100.1440 | 99.8414 | 98.4203 | 98.1544 | 96.9166 | 96.9166 | 96.6873 | 97.3933 | 98.1544 | 98.6923 | 99.2546 (39) |
| Average = Sum(39)m / 12 = |          |          |         |         |         |         |         |         |         |         |         | 98.4190 (39) |
| HLP                       | 1.1763   | 1.1726   | 1.1691  | 1.1525  | 1.1493  | 1.1349  | 1.1349  | 1.1322  | 1.1404  | 1.1493  | 1.1556  | 1.1622 (40)  |
| HLP (average)             |          |          |         |         |         |         |         |         |         |         |         | 1.1524 (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                        |          |          |          |          |          |          |         |          |          |          |          | 2.5574 (42)   |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |          |          | 94.9379 (43)  |
| Daily hot water use                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec           |
| Energy conte                             | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366  | 100.6341 | 104.4316 (44) |
| Energy content (annual)                  | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266 | 138.1136 | 149.9825 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790  | 20.7170  | 22.4974 (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)   |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design  
System) version 4.1202

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (57) |
| Combi loss                                                      | 50.9589  | 46.0274  | 49.3469  | 45.8823  | 45.4765  | 42.1368  | 43.5414  | 45.4765  | 45.8823  | 49.3469  | 49.3151  | 50.9589  | (61) |
| Total heat required for water heating calculated for each month | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 | (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                                                 | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 | (64) |
| Heat gains from water heating, kWh/month                        | 64.2337  | 56.5438  | 58.8108  | 51.9878  | 50.2464  | 44.0823  | 41.9726  | 47.0422  | 47.5697  | 54.4068  | 58.2516  | 62.6089  | (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                                                                               | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.5981   | 19.1832   | 15.6008   | 11.8108   | 8.8287    | 7.4536    | 8.0539    | 10.4687   | 14.0511   | 17.8411   | 20.8232   | 22.1983   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 230.3561  | 232.7465  | 226.7228  | 213.8991  | 197.7115  | 182.4975  | 172.3335  | 169.9432  | 175.9668  | 188.7905  | 204.9781  | 220.1922  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | (71) |
| Water heating gains (Table 5)                                                       | 86.3356   | 84.1426   | 79.0468   | 72.2053   | 67.5355   | 61.2255   | 56.4148   | 63.2288   | 66.0691   | 73.1274   | 80.9049   | 84.1517   | (72) |
| Total internal gains                                                                | 402.6505  | 400.4330  | 385.7312  | 362.2760  | 338.4365  | 315.5373  | 301.1630  | 308.0015  | 320.4478  | 344.1198  | 371.0670  | 390.9030  | (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   |
|-------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| ----- |            |                                |                                   |                                    |                              |              |
| East  | 4.0700     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       | 27.5316 (76) |
| South | 1.8000     | 46.7521                        | 0.7100                            | 0.7000                             | 0.7700                       | 28.9843 (78) |
| West  | 7.2600     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       | 49.1104 (80) |

|             |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Solar gains | 105.6263 | 197.3968 | 307.3770 | 428.4443 | 512.5358 | 520.3051 | 497.0664 | 434.4828 | 350.3314 | 229.1018 | 129.9199 | 88.0718  | (83) |
| Total gains | 508.2768 | 597.8298 | 693.1081 | 790.7203 | 850.9723 | 835.8423 | 798.2294 | 742.4842 | 670.7792 | 573.2216 | 500.9868 | 478.9748 | (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                                                                         | 59.0383 | 59.2203 | 59.3997 | 60.2575 | 60.4207 | 61.1924 | 61.1924 | 61.3375 | 60.8928 | 60.4207 | 60.0914 | 59.7509 |         |      |
| alpha                                                                       | 4.9359  | 4.9480  | 4.9600  | 5.0172  | 5.0280  | 5.0795  | 5.0795  | 5.0892  | 5.0595  | 5.0280  | 5.0061  | 4.9834  |         |      |
| util living area                                                            | 0.9981  | 0.9953  | 0.9863  | 0.9529  | 0.8619  | 0.6918  | 0.5237  | 0.5805  | 0.8357  | 0.9751  | 0.9959  | 0.9986  | (86)    |      |
| MIT                                                                         | 19.7192 | 19.8859 | 20.1627 | 20.5192 | 20.8027 | 20.9537 | 20.9907 | 20.9848 | 20.8773 | 20.4921 | 20.0410 | 19.6951 | (87)    |      |
| Th 2                                                                        | 19.9390 | 19.9419 | 19.9448 | 19.9582 | 19.9607 | 19.9725 | 19.9725 | 19.9746 | 19.9679 | 19.9607 | 19.9556 | 19.9503 | (88)    |      |
| util rest of house                                                          | 0.9974  | 0.9937  | 0.9814  | 0.9355  | 0.8133  | 0.6005  | 0.4069  | 0.4604  | 0.7617  | 0.9627  | 0.9942  | 0.9981  | (89)    |      |
| MIT 2                                                                       | 18.2334 | 18.4786 | 18.8820 | 19.3969 | 19.7695 | 19.9421 | 19.9691 | 19.9685 | 19.8702 | 19.3697 | 18.7156 | 18.2062 | (90)    |      |
| Living area fraction                                                        | 18.5791 | 18.8060 | 19.1800 | 19.6581 | 20.0099 | 20.1775 | 20.2068 | 20.2050 | 20.1045 | 19.6308 | 19.0240 | 18.5527 | (92)    |      |
| Temperature adjustment                                                      | 18.4291 | 18.6560 | 19.0300 | 19.5081 | 19.8599 | 20.0275 | 20.0568 | 20.0550 | 19.9545 | 19.4808 | 18.8740 | 18.4027 | (93)    |      |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 0.9960    | 0.9908    | 0.9754    | 0.9259    | 0.8078   | 0.6057   | 0.4167   | 0.4702   | 0.7606   | 0.9548   | 0.9915    | 0.9970    | (94)  |
| Ext temp.            | 506.2197  | 592.3521  | 676.0820  | 732.1371  | 687.4551 | 506.2797 | 332.6471 | 349.1088 | 510.1909 | 547.2959 | 496.7359  | 477.5145  | (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         | 1419.3042 | 1377.5832 | 1251.0111 | 1044.0483 | 800.9304 | 526.0120 | 335.0223 | 353.3889 | 570.1935 | 871.6895 | 1162.0022 | 1409.6793 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating per m2 | 679.3348  | 527.6753  | 427.7473  | 224.5760  | 84.4256  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 241.3489 | 478.9917  | 693.5306  | (98)  |
|                      |           |           |           |           |          |          |          |          |          |          |           | 3357.6303 | (98)  |
|                      |           |           |           |           |          |          |          |          |          |          |           | 39.3165   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3710.0888 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 679.3348 | 527.6753 | 427.7473 | 224.5760 | 84.4256  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 241.3489 | 478.9917 | 693.5306  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.5000  | 90.5000  | 90.5000   | (210)           |
| Space heating fuel (main heating system)                              | 750.6462 | 583.0667 | 472.6489 | 248.1503 | 93.2880  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 266.6838 | 529.2726 | 766.3322  | (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                                             | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9314  | 87.6813  | 87.1438  | 85.8869  | 83.5909  | 80.4000  | 80.4000  | 80.4000  | 80.4000  | 85.9487  | 87.4117  | 88.0161   | (217)           |
| Fuel for water heating, kWh/month                                     | 234.0779 | 206.9734 | 217.0190 | 195.3018 | 194.2803 | 177.9023 | 170.4439 | 190.0050 | 192.1035 | 204.6261 | 214.4207 | 228.3006  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2425.4545 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3710.0888 | (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)                   |          |          |          |          |          |          |          |          |          |          |          | 381.4286  | (232)           |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| PV Unit 0 (0.80 * 1.10 * 908 * 0.80) =                                |          |          |          |          |          |          |          |          |          |          |          | -639.1294 | (233)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5952.8425 | (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               | 3710.0888          | 0.2160                        | 801.3792 (261)           |
| Space heating - secondary                   | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                  | 2425.4545          | 0.2160                        | 523.8982 (264)           |
| Space and water heating                     |                    |                               | 1325.2773 (265)          |
| Pumps and fans                              | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                         | 381.4286           | 0.5190                        | 197.9615 (268)           |
| Energy saving/generation technologies       |                    |                               |                          |
| PV Unit                                     | -639.1294          | 0.5190                        | -331.7082 (269)          |
| Total CO2, kg/year                          |                    |                               | 1230.4557 (272)          |
| Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 14.4100 (273)            |

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

|                                                                                 |  |         |     |
|---------------------------------------------------------------------------------|--|---------|-----|
| DER                                                                             |  | 14.4100 | ZC1 |
| Total Floor Area                                                                |  | 85.4000 |     |
| Assumed number of occupants                                                     |  | 2.5574  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |  | 15.9841 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  | 2.1121  | ZC3 |
| Total CO2 emissions                                                             |  | 32.5062 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |  | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |  | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |  | 32.5062 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                     | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                     | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 219.9050 (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) = 0.1364 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3864 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3285 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4188 | 0.4106 | 0.4024 | 0.3613 | 0.3531 | 0.3120 | 0.3120 | 0.3038 | 0.3285 | 0.3531 | 0.3695 | 0.3859 (22b) |
|                 | 0.5877 | 0.5843 | 0.5809 | 0.5653 | 0.5623 | 0.5487 | 0.5487 | 0.5462 | 0.5539 | 0.5623 | 0.5683 | 0.5745 (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 Semi-glazed door                                                |                |                | 2.0200         | 1.2000                | 2.4240         |                   |                | (26a)          |                |                |                |                     |
| TER Opening Type (Uw = 1.40)                                        |                |                | 13.1300        | 1.3258                | 17.4072        |                   |                | (27)           |                |                |                |                     |
| Ground Floor                                                        |                |                | 42.7000        | 0.1300                | 5.5510         |                   |                | (28a)          |                |                |                |                     |
| External Wall                                                       | 101.3000       | 15.1500        | 86.1500        | 0.1800                | 15.5070        |                   |                | (29a)          |                |                |                |                     |
| External Roof                                                       | 42.7000        |                | 42.7000        | 0.1300                | 5.5510         |                   |                | (30)           |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 186.7000       |                       |                |                   |                | (31)           |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)... (30) + (32) = | 46.4402        |                   |                | (33)           |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                       |                |                   |                | 250.0000 (35)  |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                       |                |                   |                | 9.9912 (36)    |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                |                       |                | (33) + (36) =     |                | 56.4314 (37)   |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                       |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>42.6479 | Feb<br>42.4008 | Mar<br>42.1586 | Apr<br>41.0209        | May<br>40.8081 | Jun<br>39.8172    | Jul<br>39.8172 | Aug<br>39.6337 | Sep<br>40.1989 | Oct<br>40.8081 | Nov<br>41.2387 | Dec<br>41.6889 (38) |
| Heat transfer coeff                                                 | 99.0793        | 98.8322        | 98.5900        | 97.4523               | 97.2395        | 96.2486           | 96.2486        | 96.0651        | 96.6303        | 97.2395        | 97.6701        | 98.1202 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                       |                |                   |                |                |                |                |                | 97.4513 (39)        |
| HLP                                                                 | Jan<br>1.1602  | Feb<br>1.1573  | Mar<br>1.1544  | Apr<br>1.1411         | May<br>1.1386  | Jun<br>1.1270     | Jul<br>1.1270  | Aug<br>1.1249  | Sep<br>1.1315  | Oct<br>1.1386  | Nov<br>1.1437  | Dec<br>1.1489 (40)  |
| HLP (average)                                                       |                |                |                |                       |                |                   |                |                |                |                |                | 1.1411 (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                            |          |          |          |          |          |          |         |          |          |          |                    | 2.5574 (42)    |
| Average daily hot water use (litres/day)     |          |          |          |          |          |          |         |          |          |          |                    | 94.9379 (43)   |
|                                              | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov                | Dec            |
| Daily hot water use                          |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                              | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366  | 100.6341           | 104.4316 (44)  |
| Energy conte                                 | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266 | 138.1136           | 149.9825 (45)  |
| Energy content (annual)                      |          |          |          |          |          |          |         |          |          |          | Total = Sum(45)m = | 1493.7422 (45) |
| Distribution loss (46)m = 0.15 x (45)m       |          |          |          |          |          |          |         |          |          |          |                    |                |
|                                              | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790  | 20.7170            | 22.4974 (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 |          |          |          |          |          |          |         |          |          |          |                    |                |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Combi loss                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)   |
| Total heat required for water heating calculated for each month | 50.9589  | 46.0274  | 49.3469  | 45.8823  | 45.4765  | 42.1368  | 43.5414  | 45.4765  | 45.8823  | 49.3469  | 49.3151  | 50.9589 (61)  |
| Solar input                                                     | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 (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                        | 64.2337  | 56.5438  | 58.8108  | 51.9878  | 50.2464  | 44.0823  | 41.9726  | 47.0422  | 47.5697  | 54.4068  | 58.2516  | 62.6089 (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                                                                               | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.5981   | 19.1832   | 15.6008   | 11.8108   | 8.8287    | 7.4536    | 8.0539    | 10.4687   | 14.0511   | 17.8411   | 20.8232   | 22.1983   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 230.3561  | 232.7465  | 226.7228  | 213.8991  | 197.7115  | 182.4975  | 172.3335  | 169.9432  | 175.9668  | 188.7905  | 204.9781  | 220.1922  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | (71) |
| Water heating gains (Table 5)                                                       | 86.3356   | 84.1426   | 79.0468   | 72.2053   | 67.5355   | 61.2255   | 56.4148   | 63.2288   | 66.0691   | 73.1274   | 80.9049   | 84.1517   | (72) |
| Total internal gains                                                                | 402.6505  | 400.4330  | 385.7312  | 362.2760  | 338.4365  | 315.5373  | 301.1630  | 308.0015  | 320.4478  | 344.1198  | 371.0670  | 390.9030  | (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    |
| East        |          |          |          |          | 4.0700     | 19.6403                        |          | 0.6300                            | 0.7000                             |          | 0.7700                       | 24.4294 (76)  |
| South       |          |          |          |          | 1.8000     | 46.7521                        |          | 0.6300                            | 0.7000                             |          | 0.7700                       | 25.7185 (78)  |
| West        |          |          |          |          | 7.2600     | 19.6403                        |          | 0.6300                            | 0.7000                             |          | 0.7700                       | 43.5768 (80)  |
|             |          |          |          |          |            |                                |          |                                   |                                    |          |                              |               |
| Solar gains | 93.7248  | 175.1549 | 272.7429 | 380.1689 | 454.7852   | 461.6791                       | 441.0589 | 385.5270                          | 310.8575                           | 203.2875 | 115.2810                     | 78.1482 (83)  |
| Total gains | 496.3753 | 575.5879 | 658.4741 | 742.4449 | 793.2218   | 777.2164                       | 742.2219 | 693.5284                          | 631.3052                           | 547.4073 | 486.3480                     | 469.0512 (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                                                                         | 59.8566 | 60.0063 | 60.1537 | 60.8560 | 60.9892 | 61.6171 | 61.6171 | 61.7348 | 61.3737 | 60.9892 | 60.7203 | 60.4417 |              |
| alpha                                                                       | 4.9904  | 5.0004  | 5.0102  | 5.0571  | 5.0659  | 5.1078  | 5.1078  | 5.1157  | 5.0916  | 5.0659  | 5.0480  | 5.0294  |              |
| util living area                                                            | 0.9983  | 0.9960  | 0.9888  | 0.9620  | 0.8847  | 0.7264  | 0.5562  | 0.6126  | 0.8578  | 0.9790  | 0.9964  | 0.9987  | (86)         |
| MIT                                                                         | 19.7277 | 19.8821 | 20.1446 | 20.4879 | 20.7768 | 20.9432 | 20.9882 | 20.9811 | 20.8618 | 20.4761 | 20.0388 | 19.7021 | (87)         |
| Th 2                                                                        | 19.9520 | 19.9543 | 19.9566 | 19.9674 | 19.9694 | 19.9788 | 19.9788 | 19.9806 | 19.9752 | 19.9694 | 19.9653 | 19.9611 | (88)         |
| util rest of house                                                          | 0.9977  | 0.9947  | 0.9847  | 0.9474  | 0.8408  | 0.6356  | 0.4345  | 0.4890  | 0.7885  | 0.9683  | 0.9949  | 0.9983  | (89)         |
| MIT 2                                                                       | 18.2549 | 18.4820 | 18.8650 | 19.3621 | 19.7480 | 19.9405 | 19.9744 | 19.9727 | 19.8622 | 19.3545 | 18.7193 | 18.2240 | (90)         |
| Living area fraction                                                        | 18.5976 | 18.8077 | 19.1627 | 19.6240 | 19.9874 | 20.1738 | 20.2103 | 20.2073 | 20.0948 | 19.6154 | 19.0263 | 18.5679 | (92)         |
| Temperature adjustment                                                      | 18.5976 | 18.8077 | 19.1627 | 19.6240 | 19.9874 | 20.1738 | 20.2103 | 20.2073 | 20.0948 | 19.6154 | 19.0263 | 18.5679 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 494.6517  | 571.2584  | 645.5790  | 698.7879  | 667.6337 | 508.5550 | 343.6183 | 359.0689 | 503.7247 | 527.3336 | 482.8837  | 467.8142  | (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     | 1416.5967 | 1374.5310 | 1248.4175 | 1045.0827 | 805.8580 | 536.4730 | 347.4858 | 365.7514 | 579.2748 | 876.6564 | 1164.8447 | 1409.7837 | (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    | 685.9271  | 539.7992  | 448.5119  | 249.3323  | 102.8389 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 259.8961 | 491.0120  | 700.8253  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 3478.1427 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 40.7277   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| 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                                             |          |          |          |          |          |          |          |          |          |          |          |          | 3723.9215 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 685.9271 | 539.7992 | 448.5119 | 249.3323 | 102.8389 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 259.8961 | 491.0120 | 700.8253 | (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)                              | 734.3973 | 577.9435 | 480.2054 | 266.9511 | 110.1059 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 278.2614 | 525.7088 | 750.3483 | (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                                             | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 | (64)            |
| Efficiency of water heater                                            | 87.8496  | 87.6269  | 87.1489  | 86.0472  | 83.9360  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 86.0327  | 87.3643  | 87.9354  | (216)           |
| Fuel for water heating, kWh/month                                     | 234.2958 | 207.1018 | 217.0064 | 194.9380 | 193.4816 | 178.1238 | 170.6562 | 190.2417 | 192.3427 | 204.4263 | 214.5370 | 228.5102 | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          |          | 2425.6615 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          |          | 3723.9215 (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)                   |          |          |          |          |          |          |          |          |          |          |          |          | 381.4286 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          |          | 6606.0116 (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                                                                     | 3723.9215          | 0.2160                        | 804.3671 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2425.6615          | 0.2160                        | 523.9429 (264)           |
| Space and water heating                                                                           |                    |                               | 1328.3099 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 381.4286           | 0.5190                        | 197.9615 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1565.1964 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 15.5540 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3180 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4558 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (15.5540 * 1.00) + 2.3180 + 0.4558, rounded to 2 d.p. |                    |                               | 18.3300 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                   | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                   | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 219.9050 (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) = 0.1364 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3864 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3285 (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 | 0.4188 | 0.4106 | 0.4024 | 0.3613 | 0.3531 | 0.3120 | 0.3120 | 0.3038 | 0.3285 | 0.3531 | 0.3695 | 0.3859 (22b) |
| Effective ac    | 0.5877 | 0.5843 | 0.5809 | 0.5653 | 0.5623 | 0.5487 | 0.5487 | 0.5462 | 0.5539 | 0.5623 | 0.5683 | 0.5745 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 42.6479 | 42.4008 | 42.1586 | 41.0209 | 40.8081 | 39.8172 | 39.8172 | 39.6337 | 40.1989 | 40.8081 | 41.2387 | 41.6889 (38) |
| Heat transfer coeff       | 98.8668 | 98.6197 | 98.3775 | 97.2399 | 97.0270 | 96.0361 | 96.0361 | 95.8526 | 96.4178 | 97.0270 | 97.4576 | 97.9078 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 97.2388 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1577 | 1.1548 | 1.1520 | 1.1386 | 1.1361 | 1.1245 | 1.1245 | 1.1224 | 1.1290 | 1.1361 | 1.1412 | 1.1465 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1386 (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 2.5574 (42)  
Average daily hot water use (litres/day) 94.9379 (43)

|                                        | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
|----------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Daily hot water use                    | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366  | 100.6341 | 104.4316 (44)                     |
| Energy conte                           | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266 | 138.1136 | 149.9825 (45)                     |
| Energy content (annual)                |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1493.7422 (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)                       |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                              |         |         |         |         |         |         |         |         |         |         |         |              |
|----------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| If cylinder contains dedicated solar storage | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (57)  |
| Primary loss                                 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (59)  |
| Heat gains from water heating, kWh/month     | 32.9097 | 28.7830 | 29.7015 | 25.8945 | 24.8464 | 21.4405 | 19.8678 | 22.7986 | 23.0709 | 26.8869 | 29.3491 | 31.8713 (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                                                                               | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.5981   | 19.1832   | 15.6008   | 11.8108   | 8.8287    | 7.4536    | 8.0539    | 10.4687   | 14.0511   | 17.8411   | 20.8232   | 22.1983   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 230.3561  | 232.7465  | 226.7228  | 213.8991  | 197.7115  | 182.4975  | 172.3335  | 169.9432  | 175.9668  | 188.7905  | 204.9781  | 220.1922  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | (71) |
| Water heating gains (Table 5)                                                       | 44.2334   | 42.8319   | 39.9214   | 35.9646   | 33.3957   | 29.7785   | 26.7040   | 30.6433   | 32.0429   | 36.1383   | 40.7627   | 42.8377   | (72) |
| Total internal gains                                                                | 357.5484  | 356.1223  | 343.6057  | 323.0353  | 301.2967  | 281.0903  | 268.4522  | 272.4159  | 283.4216  | 304.1307  | 327.9248  | 346.5890  | (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   |
|-------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| East  | 4.0700     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       | 27.5316 (76) |
| South | 1.8000     | 46.7521                        | 0.7100                            | 0.7000                             | 0.7700                       | 28.9843 (78) |
| West  | 7.2600     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       | 49.1104 (80) |

|             |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Solar gains | 105.6263 | 197.3968 | 307.3770 | 428.4443 | 512.5358 | 520.3051 | 497.0664 | 434.4828 | 350.3314 | 229.1018 | 129.9199 | 88.0718  | (83) |
| Total gains | 463.1747 | 553.5191 | 650.9827 | 751.4796 | 813.8324 | 801.3954 | 765.5186 | 706.8987 | 633.7530 | 533.2325 | 457.8446 | 434.6608 | (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                                                                         | 59.9853 | 60.1356 | 60.2836 | 60.9889 | 61.1227 | 61.7534 | 61.7534 | 61.8716 | 61.5089 | 61.1227                   | 60.8527 | 60.5729 |              |
| alpha                                                                       | 4.9990  | 5.0090  | 5.0189  | 5.0659  | 5.0748  | 5.1169  | 5.1169  | 5.1248  | 5.1006  | 5.0748                    | 5.0568  | 5.0382  |              |
| util living area                                                            | 0.9987  | 0.9967  | 0.9893  | 0.9601  | 0.8753  | 0.7097  | 0.5398  | 0.6016  | 0.8557  | 0.9811                    | 0.9973  | 0.9991  | (86)         |
| MIT                                                                         | 19.6948 | 19.8616 | 20.1398 | 20.4985 | 20.7905 | 20.9493 | 20.9897 | 20.9827 | 20.8642 | 20.4643                   | 20.0108 | 19.6678 | (87)         |
| Th 2                                                                        | 19.9540 | 19.9563 | 19.9586 | 19.9694 | 19.9714 | 19.9808 | 19.9808 | 19.9826 | 19.9772 | 19.9714                   | 19.9673 | 19.9631 | (88)         |
| util rest of house                                                          | 0.9983  | 0.9955  | 0.9854  | 0.9449  | 0.8295  | 0.6188  | 0.4211  | 0.4795  | 0.7860  | 0.9713                    | 0.9961  | 0.9988  | (89)         |
| MIT 2                                                                       | 18.7622 | 18.9303 | 19.2083 | 19.5657 | 19.8309 | 19.9578 | 19.9783 | 19.9777 | 19.9016 | 19.5400                   | 19.0884 | 18.7425 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.2327  | (91)         |
| MIT                                                                         | 18.9792 | 19.1470 | 19.4250 | 19.7827 | 20.0542 | 20.1885 | 20.2136 | 20.2115 | 20.1255 | 19.7550                   | 19.3030 | 18.9578 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | 0.0000  |              |
| adjusted MIT                                                                | 18.9792 | 19.1470 | 19.4250 | 19.7827 | 20.0542 | 20.1885 | 20.2136 | 20.2115 | 20.1255 | 19.7550                   | 19.3030 | 18.9578 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec       |       |
| Useful gains         | 462.1282  | 550.3509  | 639.7490  | 707.5073  | 678.4998 | 511.7624 | 343.6981 | 359.2441 | 505.5436 | 516.4867     | 455.5823  | 433.9451  | (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     | 1451.2839 | 1405.0329 | 1271.5310 | 1058.2348 | 810.5795 | 536.6959 | 347.0360 | 365.3460 | 580.9696 | 888.2842     | 1189.2757 | 1444.9019 | (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    | 735.9318  | 574.3463  | 470.0458  | 252.5238  | 98.2673  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 276.6173     | 528.2593  | 752.1518  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 3688.1436 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 43.1867   | (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  | 902.7397  | 710.6674 | 728.4801 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (100)  |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.8873    | 0.9402   | 0.9179   | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (101)  |
| Useful loss                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 801.0284  | 668.1884 | 668.6953 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (102)  |
| Total gains                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1032.9949 | 989.0890 | 922.3480 | 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  | 167.0159  | 238.7501 | 188.7176 | 0.0000  | 0.0000  | 0.0000 | 0.0000 | (104)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

|                                          |        |        |        |        |         |         |         |        |        |        |        |                |
|------------------------------------------|--------|--------|--------|--------|---------|---------|---------|--------|--------|--------|--------|----------------|
| Space cooling                            |        |        |        |        |         |         |         |        |        |        |        | 594.4835 (104) |
| Cooled fraction                          |        |        |        |        |         |         |         |        |        |        |        | 1.0000 (105)   |
| Intermittency factor (Table 10b)         |        |        |        |        |         |         |         |        |        |        |        |                |
|                                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.2500  | 0.2500  | 0.2500  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (106)          |
| Space cooling kWh                        |        |        |        |        |         |         |         |        |        |        |        |                |
|                                          | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.7540 | 59.6875 | 47.1794 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (107)          |
| Space cooling                            |        |        |        |        |         |         |         |        |        |        |        | 148.6209 (107) |
| Space cooling per m2                     |        |        |        |        |         |         |         |        |        |        |        | 1.7403 (108)   |
| Energy for space heating                 |        |        |        |        |         |         |         |        |        |        |        | 43.1867 (99)   |
| Energy for space cooling                 |        |        |        |        |         |         |         |        |        |        |        | 1.7403 (108)   |
| Total                                    |        |        |        |        |         |         |         |        |        |        |        | 44.9270 (109)  |
| Dwelling Fabric Energy Efficiency (DFEE) |        |        |        |        |         |         |         |        |        |        |        | 44.9 (109)     |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                     | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                     | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 219.9050 (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)       |
| Air changes per hour                                                      |                 |                      |       |                             |                            |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 30.0000 / (5) = 0.1364 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.3864 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3285 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4188 | 0.4106 | 0.4024 | 0.3613 | 0.3531 | 0.3120 | 0.3120 | 0.3038 | 0.3285 | 0.3531 | 0.3695 | 0.3859 (22b) |
|                 | 0.5877 | 0.5843 | 0.5809 | 0.5653 | 0.5623 | 0.5487 | 0.5487 | 0.5462 | 0.5539 | 0.5623 | 0.5683 | 0.5745 (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 Semi-glazed door                                                |             |                | 2.0200        | 1.2000                | 2.4240       |                   |               | (26a)         |         |         |         |              |
| TER Opening Type (Uw = 1.40)                                        |             |                | 13.1300       | 1.3258                | 17.4072      |                   |               | (27)          |         |         |         |              |
| Ground Floor                                                        |             |                | 42.7000       | 0.1300                | 5.5510       |                   |               | (28a)         |         |         |         |              |
| External Wall                                                       | 101.3000    | 15.1500        | 86.1500       | 0.1800                | 15.5070      |                   |               | (29a)         |         |         |         |              |
| External Roof                                                       | 42.7000     |                | 42.7000       | 0.1300                | 5.5510       |                   |               | (30)          |         |         |         |              |
| Total net area of external elements Aum(A, m2)                      |             |                | 186.7000      |                       |              |                   |               | (31)          |         |         |         |              |
| Fabric heat loss, W/K = Sum (A x U)                                 |             |                |               | (26)... (30) + (32) = | 46.4402      |                   |               | (33)          |         |         |         |              |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |             |                |               |                       |              |                   |               | 250.0000 (35) |         |         |         |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |             |                |               |                       |              |                   |               | 9.9912 (36)   |         |         |         |              |
| Total fabric heat loss                                              |             |                |               |                       |              | (33) + (36) =     |               | 56.4314 (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                                                 | 42.6479     | 42.4008        | 42.1586       | 41.0209               | 40.8081      | 39.8172           | 39.8172       | 39.6337       | 40.1989 | 40.8081 | 41.2387 | 41.6889 (38) |
| Average = Sum(39)m / 12 =                                           | 99.0793     | 98.8322        | 98.5900       | 97.4523               | 97.2395      | 96.2486           | 96.2486       | 96.0651       | 96.6303 | 97.2395 | 97.6701 | 98.1202 (39) |
|                                                                     |             |                |               |                       |              |                   |               |               |         |         |         | 97.4513 (39) |
| HLP                                                                 | Jan         | Feb            | Mar           | Apr                   | May          | Jun               | Jul           | Aug           | Sep     | Oct     | Nov     | Dec          |
| HLP (average)                                                       | 1.1602      | 1.1573         | 1.1544        | 1.1411                | 1.1386       | 1.1270            | 1.1270        | 1.1249        | 1.1315  | 1.1386  | 1.1437  | 1.1489 (40)  |
| Days in month                                                       |             |                |               |                       |              |                   |               |               |         |         |         | 1.1411 (40)  |
|                                                                     | 31          | 28             | 31            | 30                    | 31           | 30                | 31            | 31            | 30      | 31      | 30      | 31 (41)      |

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

|                                              |          |          |          |          |          |          |         |          |          |          |          |                                   |
|----------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Assumed occupancy                            |          |          |          |          |          |          |         |          |          |          |          | 2.5574 (42)                       |
| Average daily hot water use (litres/day)     |          |          |          |          |          |          |         |          |          |          |          | 94.9379 (43)                      |
| Daily hot water use                          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Energy conte                                 | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366  | 100.6341 | 104.4316 (44)                     |
| Energy content (annual)                      | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266 | 138.1136 | 149.9825 (45)                     |
| Distribution loss (46)m = 0.15 x (45)m       |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1493.7422 (45) |
|                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (46)                       |
| Water storage loss:                          |          |          |          |          |          |          |         |          |          |          |          |                                   |
| Total storage loss                           | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (56)                       |
| If cylinder contains dedicated solar storage |          |          |          |          |          |          |         |          |          |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

|                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| 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)  |
|                                          | 32.9097 | 28.7830 | 29.7015 | 25.8945 | 24.8464 | 21.4405 | 19.8678 | 22.7986 | 23.0709 | 26.8869 | 29.3491 | 31.8713 (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                                                                               | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.5981   | 19.1832   | 15.6008   | 11.8108   | 8.8287    | 7.4536    | 8.0539    | 10.4687   | 14.0511   | 17.8411   | 20.8232   | 22.1983   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 230.3561  | 232.7465  | 226.7228  | 213.8991  | 197.7115  | 182.4975  | 172.3335  | 169.9432  | 175.9668  | 188.7905  | 204.9781  | 220.1922  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | (71) |
| Water heating gains (Table 5)                                                       | 44.2334   | 42.8319   | 39.9214   | 35.9646   | 33.3957   | 29.7785   | 26.7040   | 30.6433   | 32.0429   | 36.1383   | 40.7627   | 42.8377   | (72) |
| Total internal gains                                                                | 357.5484  | 356.1223  | 343.6057  | 323.0353  | 301.2967  | 281.0903  | 268.4522  | 272.4159  | 283.4216  | 304.1307  | 327.9248  | 346.5890  | (73) |

#### 6. Solar gains

| [Jan] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | Specific data<br>or Table 6b | Specific data<br>or Table 6c | FF     | Access<br>factor<br>Table 6d | Gains<br>W |
|-------|------------|--------------------------------|------------------------------|------------------------------|--------|------------------------------|------------|
| East  | 4.0700     | 19.6403                        | 0.6300                       | 0.7000                       | 0.7700 | 24.4294                      | (76)       |
| South | 1.8000     | 46.7521                        | 0.6300                       | 0.7000                       | 0.7700 | 25.7185                      | (78)       |
| West  | 7.2600     | 19.6403                        | 0.6300                       | 0.7000                       | 0.7700 | 43.5768                      | (80)       |

|             |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Solar gains | 93.7248  | 175.1549 | 272.7429 | 380.1689 | 454.7852 | 461.6791 | 441.0589 | 385.5270 | 310.8575 | 203.2875 | 115.2810 | 78.1482  | (83) |
| Total gains | 451.2731 | 531.2772 | 616.3487 | 703.2042 | 756.0819 | 742.7695 | 709.5111 | 657.9429 | 594.2791 | 507.4182 | 443.2058 | 424.7372 | (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                                                                         | 59.8566 | 60.0063 | 60.1537 | 60.8560 | 60.9892 | 61.6171 | 61.6171 | 61.7348 | 61.3737                   | 60.9892 | 60.7203 | 60.4417 |         |      |
| alpha                                                                       | 4.9904  | 5.0004  | 5.0102  | 5.0571  | 5.0659  | 5.1078  | 5.1078  | 5.1157  | 5.0916                    | 5.0659  | 5.0480  | 5.0294  |         |      |
| util living area                                                            | 0.9989  | 0.9972  | 0.9915  | 0.9691  | 0.9001  | 0.7494  | 0.5789  | 0.6401  | 0.8799                    | 0.9846  | 0.9976  | 0.9992  | (86)    |      |
| MIT                                                                         | 19.6785 | 19.8343 | 20.1007 | 20.4518 | 20.7534 | 20.9345 | 20.9859 | 20.9771 | 20.8413                   | 20.4361 | 19.9921 | 19.6537 | (87)    |      |
| Th 2                                                                        | 19.9520 | 19.9543 | 19.9566 | 19.9674 | 19.9694 | 19.9788 | 19.9788 | 19.9806 | 19.9752                   | 19.9694 | 19.9653 | 19.9611 | (88)    |      |
| util rest of house                                                          | 0.9985  | 0.9963  | 0.9884  | 0.9567  | 0.8598  | 0.6594  | 0.4537  | 0.5136  | 0.8162                    | 0.9765  | 0.9966  | 0.9989  | (89)    |      |
| MIT 2                                                                       | 18.7443 | 18.9016 | 19.1682 | 19.5204 | 19.7996 | 19.9480 | 19.9752 | 19.9739 | 19.8839                   | 19.5114 | 19.0682 | 18.7267 | (90)    |      |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.2327  | (91)    |      |
| MIT                                                                         | 18.9617 | 19.1186 | 19.3852 | 19.7371 | 20.0215 | 20.1775 | 20.2103 | 20.2073 | 20.1067                   | 19.7266 | 19.2832 | 18.9424 | (92)    |      |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |         |      |
| adjusted MIT                                                                | 18.9617 | 19.1186 | 19.3852 | 19.7371 | 20.0215 | 20.1775 | 20.2103 | 20.2073 | 20.1067                   | 19.7266 | 19.2832 | 18.9424 | (93)    |      |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
|                      | 0.9980    | 0.9952    | 0.9861    | 0.9533    | 0.8621   | 0.6785   | 0.4832   | 0.5433   | 0.8258   | 0.9739   | 0.9957    | 0.9985    | (94)  |
| Useful gains         | 450.3622  | 528.7187  | 607.7696  | 670.3592  | 651.8440 | 503.9644 | 342.8035 | 357.4621 | 490.7716 | 494.1750 | 441.2995  | 424.1052  | (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     | 1452.6704 | 1405.2550 | 1270.3489 | 1056.1044 | 809.1817 | 536.8296 | 347.4894 | 365.7468 | 580.4278 | 887.4634 | 1189.9296 | 1446.5263 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 745.7173  | 589.0324  | 492.9590  | 277.7366  | 117.0592 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 292.6066 | 539.0136  | 760.6813  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 3814.8060 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 44.6699   | (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  | 904.7369 | 712.2397 | 730.0948 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (100)  |
| Utilisation                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.8618   | 0.9237   | 0.8986   | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (101)  |
| Useful loss                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 779.6991 | 657.9111 | 656.0277 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (102)  |
| Total gains                                         | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 964.4711 | 923.6257 | 865.1269 | 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  | 133.0358 | 197.6917 | 155.5698 | 0.0000  | 0.0000  | 0.0000 | 0.0000   | (104)  |
| Space cooling                                       |        |        |        |        |         |          |          |          |         |         |        | 486.2974 | (104)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### 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 (106)   |
| Space cooling kWh                      | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 33.2590 | 49.4229 | 38.8925 | 0.0000 | 0.0000 | 0.0000 (107)   |
| Space cooling                          |                          |        |        |        |        |         |         |         |        |        | 121.5743 (107) |
| Space cooling per m2                   |                          |        |        |        |        |         |         |         |        |        | 1.4236 (108)   |
| Energy for space heating               |                          |        |        |        |        |         |         |         |        |        | 44.6699 (99)   |
| Energy for space cooling               |                          |        |        |        |        |         |         |         |        |        | 1.4236 (108)   |
| Total                                  |                          |        |        |        |        |         |         |         |        |        | 46.0934 (109)  |
| Target Fabric Energy Efficiency (TFEE) |                          |        |        |        |        |         |         |         |        |        | 53.0 (109)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### Calculation of Heat Demand 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
Calculation of Heat Demand 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                   | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                   | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 219.9050 (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                          |                              |                      |       |       | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 40.0000 / (5) = 0.1819 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                        |
| Measured/design AP50                                 |                              |                      |       |       | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |       | 0.4319 (18)                |
| Number of sides sheltered                            |                              |                      |       |       | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3671 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.6000 | 5.1000 | 4.8000 | 4.5000 | 4.7000 | 4.2000 | 4.4000 | 4.2000 | 4.4000 | 4.8000 | 4.9000 | 5.1000 (22)  |
| Wind factor     | 1.4000 | 1.2750 | 1.2000 | 1.1250 | 1.1750 | 1.0500 | 1.1000 | 1.0500 | 1.1000 | 1.2000 | 1.2250 | 1.2750 (22a) |
| Adj infilt rate | 0.5140 | 0.4681 | 0.4405 | 0.4130 | 0.4314 | 0.3855 | 0.4038 | 0.3855 | 0.4038 | 0.4405 | 0.4497 | 0.4681 (22b) |
| Effective ac    | 0.6321 | 0.6095 | 0.5970 | 0.5853 | 0.5930 | 0.5743 | 0.5815 | 0.5743 | 0.5815 | 0.5970 | 0.6011 | 0.6095 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 45.8689  | 44.2338  | 43.3261 | 42.4733 | 43.0357 | 41.6756 | 42.2013 | 41.6756 | 42.2013 | 43.3261 | 43.6225 | 44.2338 (38)  |
| Heat transfer coeff       | 102.0878 | 100.4527 | 99.5450 | 98.6923 | 99.2546 | 97.8946 | 98.4203 | 97.8946 | 98.4203 | 99.5450 | 99.8414 | 100.4527 (39) |
| Average = Sum(39)m / 12 = |          |          |         |         |         |         |         |         |         |         |         | 99.4751 (39)  |
| HLP                       | 1.1954   | 1.1763   | 1.1656  | 1.1556  | 1.1622  | 1.1463  | 1.1525  | 1.1463  | 1.1525  | 1.1656  | 1.1691  | 1.1763 (40)   |
| HLP (average)             |          |          |         |         |         |         |         |         |         |         |         | 1.1636 (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                        |          |          |          |          |          |          |         |          |          |                    |          | 2.5574 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |                    |          | 94.9379 (43)   |
| Daily hot water use                      | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366            | 100.6341 | 104.4316 (44)  |
| Energy conte                             | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266           | 138.1136 | 149.9825 (45)  |
| Energy content (annual)                  |          |          |          |          |          |          |         |          |          | Total = Sum(45)m = |          | 1493.7422 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790            | 20.7170  | 22.4974 (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)    |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design  
System) version 4.12r02

surecalc ltd

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                   | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                   | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 219.9050 (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                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.1819 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.4319 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3671 (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 | 0.4681 | 0.4589 | 0.4497 | 0.4038 | 0.3946 | 0.3488 | 0.3488 | 0.3396 | 0.3671 | 0.3946 | 0.4130 | 0.4314 (22b) |
| Effective ac    | 0.6095 | 0.6053 | 0.6011 | 0.5615 | 0.5779 | 0.5608 | 0.5608 | 0.5577 | 0.5674 | 0.5779 | 0.5853 | 0.5930 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 44.2338  | 43.9251  | 43.6225 | 42.2013 | 41.9354 | 40.6976 | 40.6976 | 40.4684 | 41.1744 | 41.9354 | 42.4733 | 43.0357 (38) |
| Heat transfer coeff       | 100.4527 | 100.1440 | 99.8414 | 98.4203 | 98.1544 | 96.9166 | 96.9166 | 96.6873 | 97.3933 | 98.1544 | 98.6923 | 99.2546 (39) |
| Average = Sum(39)m / 12 = |          |          |         |         |         |         |         |         |         |         |         | 98.4190 (39) |
| HLP                       | 1.1763   | 1.1726   | 1.1691  | 1.1525  | 1.1493  | 1.1349  | 1.1349  | 1.1322  | 1.1404  | 1.1493  | 1.1556  | 1.1622 (40)  |
| HLP (average)             |          |          |         |         |         |         |         |         |         |         |         | 1.1524 (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                        |          |          |          |          |          |          |         |          |          |                    |          | 2.5574 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |                    |          | 94.9379 (43)   |
| Daily hot water use                      | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366            | 100.6341 | 104.4316 (44)  |
| Energy conte                             | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266           | 138.1136 | 149.9825 (45)  |
| Energy content (annual)                  |          |          |          |          |          |          |         |          |          | Total = Sum(45)m = |          | 1493.7422 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790            | 20.7170  | 22.4974 (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)    |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF ENERGY RATINGS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 50.9589  | 46.0274  | 49.3469  | 45.8823  | 45.4765  | 42.1368  | 43.5414  | 45.4765  | 45.8823  | 49.3469  | 49.3151  | 50.9589 (61)  |
| Total heat required for water heating calculated for each month | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 (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                                                 | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 (64) |
| Heat gains from water heating, kWh/month                        | 64.2337  | 56.5438  | 58.8108  | 51.9878  | 50.2464  | 44.0823  | 41.9726  | 47.0422  | 47.5697  | 54.4068  | 58.2516  | 62.6089 (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                                                                               | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 53.9952   | 47.9580   | 39.0021   | 22.0718   | 18.6340   | 20.1347   | 26.1718   | 35.1278   | 44.6028   | 52.0580   | 55.4959   | (67)           |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 343.8150  | 347.3828  | 338.3922  | 319.2524  | 295.0918  | 272.3843  | 257.2143  | 253.6465  | 262.6371  | 281.7769  | 305.9375  | 328.6450 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017 (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 (71) |
| Water heating gains (Table 5)                                                       | 86.3356   | 84.1426   | 79.0468   | 72.2053   | 67.5355   | 61.2255   | 56.4148   | 63.2288   | 66.0691   | 73.1274   | 80.9049   | 84.1517 (72)   |
| Total internal gains                                                                | 591.1952  | 586.5327  | 563.4905  | 528.0342  | 491.7485  | 459.2931  | 440.8131  | 450.0965  | 470.8833  | 506.5564  | 545.9498  | 575.3420 (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   |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|----------|--------------|
| East        |          |          |          | 4.0700     | 19.6403                        | 0.7100                            | 0.7000                             |          |          | 0.7700                       |          |          | 27.5316 (76) |
| South       |          |          |          | 1.8000     | 46.7521                        | 0.7100                            | 0.7000                             |          |          | 0.7700                       |          |          | 28.9843 (78) |
| West        |          |          |          | 7.2600     | 19.6403                        | 0.7100                            | 0.7000                             |          |          | 0.7700                       |          |          | 49.1104 (80) |
|             |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |              |
| Solar gains | 105.6263 | 197.3968 | 307.3770 | 428.4443   | 512.5358                       | 520.3051                          | 497.0664                           | 434.4828 | 350.3314 | 229.1018                     | 129.9199 | 88.0718  | (83)         |
| Total gains | 696.8215 | 783.9296 | 870.8674 | 956.4785   | 1004.2843                      | 979.5981                          | 937.8795                           | 884.5793 | 821.2147 | 735.6582                     | 675.8696 | 663.4137 | (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                                                                         | 59.0383      | 59.2203 | 59.3997 | 60.2575 | 60.4207 | 61.1924 | 61.1924 | 61.3375 | 60.8928 | 60.4207 | 60.0914 | 59.7509      |
| alpha                                                                       | 4.9359       | 4.9480  | 4.9600  | 5.0172  | 5.0280  | 5.0795  | 5.0795  | 5.0892  | 5.0595  | 5.0280  | 5.0061  | 4.9834       |
| util living area                                                            | 0.9923       | 0.9853  | 0.9663  | 0.9105  | 0.7919  | 0.6089  | 0.4501  | 0.4951  | 0.7417  | 0.9375  | 0.9851  | 0.9939 (86)  |
| MIT                                                                         | 19.9207      | 20.0801 | 20.3357 | 20.6483 | 20.8707 | 20.9737 | 20.9953 | 20.9925 | 20.9307 | 20.6358 | 20.2244 | 19.8938 (87) |
| Th 2                                                                        | 19.9390      | 19.9419 | 19.9448 | 19.9582 | 19.9607 | 19.9725 | 19.9725 | 19.9746 | 19.9679 | 19.9607 | 19.9556 | 19.9503 (88) |
| util rest of house                                                          | 0.9899       | 0.9807  | 0.9556  | 0.8827  | 0.7342  | 0.5213  | 0.3474  | 0.3887  | 0.6579  | 0.9117  | 0.9796  | 0.9919 (89)  |
| MIT 2                                                                       | 18.5264      | 18.7588 | 19.1259 | 19.5653 | 19.8423 | 19.9562 | 19.9708 | 19.9718 | 19.9176 | 19.5611 | 18.9794 | 18.4955 (90) |
| Living area fraction                                                        | 18.8508      | 19.0662 | 19.4074 | 19.8172 | 20.0816 | 20.1930 | 20.2092 | 20.2093 | 20.1533 | 19.8111 | 19.2691 | 18.8208 (92) |
| Temperature adjustment                                                      | 18.7008      | 18.9162 | 19.2574 | 19.6672 | 19.9316 | 20.0430 | 20.0592 | 20.0593 | 20.0033 | 19.6611 | 19.1191 | 18.6708 (93) |

#### 8. Space heating requirement

|                                  |              |           |           |           |          |          |          |          |          |          |           |                |
|----------------------------------|--------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation                      | Jan          | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
| Useful gains                     | 686.8759     | 763.9186  | 824.2460  | 835.4340  | 735.5388 | 516.7700 | 334.0928 | 351.7958 | 542.8474 | 663.7915 | 657.8531  | 655.7363 (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                 | 1446.6008    | 1403.6412 | 1273.7153 | 1059.7154 | 807.9692 | 527.5141 | 335.2535 | 353.8060 | 574.9392 | 889.3900 | 1186.1931 | 1436.2984 (97) |
| Month fracti                     | 1.0000       | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating kWh                | 565.2353     | 429.8935  | 334.4052  | 161.4826  | 53.8882  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 167.8453 | 380.4048  | 580.7382 (98)  |
| Space heating                    | (98) / (4) = |           |           |           |          |          |          |          |          |          |           |                |
| Space heating per m <sup>2</sup> | 31.3102 (99) |           |           |           |          |          |          |          |          |          |           |                |

#### 8c. Space cooling requirement

Not applicable

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## Calculation Type: New Build (As Designed)



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

|                                                                       |          |          |          |          |          |          |          |          |          |           |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |           |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |           |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |           |          |           | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |           |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |           |          |           | 2954.5780 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov      | Dec       |                 |
| Space heating requirement                                             | 565.2353 | 429.8935 | 334.4052 | 161.4826 | 53.8882  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 167.8453  | 380.4048 | 580.7382  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.5000   | 90.5000  | 90.5000   | (210)           |
| Space heating fuel (main heating system)                              | 624.5694 | 475.0205 | 369.5085 | 178.4338 | 59.5449  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 185.4644  | 420.3368 | 641.6996  | (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                                             | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734  | 187.4287 | 200.9414  | (64)            |
| Efficiency of water heater (217)m                                     | 87.5637  | 87.2466  | 86.5714  | 85.0560  | 82.6995  | 80.4000  | 80.4000  | 80.4000  | 80.4000  | 85.0342   | 86.8968  | 87.6689   | (216)           |
| Fuel for water heating, kWh/month                                     | 235.0610 | 208.0044 | 218.4539 | 197.2097 | 196.3744 | 177.9023 | 170.4439 | 190.0050 | 192.1035 | 206.8268  | 215.6911 | 229.2048  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |           |          | 2437.2808 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |           |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |           |          | 2954.5780 | (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)                   |          |          |          |          |          |          |          |          |          |           |          | 381.4286  | (232)           |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |          |          |          |          |          |           |          |           |                 |
| PV Unit 0 (0.80 * 1.10 * 908 * 0.80) =                                |          |          |          |          |          |          |          |          |          | -639.1294 |          | -639.1294 | (233)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |           |          | 5209.1580 | (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         | 2954.5780        | 3.4800              | 102.8193 (240)      |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 2437.2808        | 3.4800              | 84.8174 (247)       |
| Pumps and fans for heating            | 75.0000          | 13.1900             | 9.8925 (249)        |
| Energy for lighting                   | 381.4286         | 13.1900             | 50.3104 (250)       |
| Additional standing charges           |                  |                     | 120.0000 (251)      |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | -639.1294        | 13.1900             | -84.3012 (252)      |
| Total energy cost                     |                  |                     | 283.5385 (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] = | 0.9132 (257) |
| SAP value                        |                                  | 87.2603      |
| 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         | 2954.5780          | 0.2160                        | 638.1888 (261)           |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)            | 2437.2808          | 0.2160                        | 526.4526 (264)           |
| Space and water heating               |                    |                               | 1164.6415 (265)          |
| Pumps and fans                        | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                   | 381.4286           | 0.5190                        | 197.9615 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -639.1294          | 0.5190                        | -331.7082 (269)          |
| Total kg/year                         |                    |                               | 1069.8198 (272)          |
| CO2 emissions per m2                  |                    |                               | 12.5300 (273)            |
| EI value                              |                    |                               | 89.0065                  |
| EI rating                             |                    |                               | 89 (274)                 |
| EI band                               |                    |                               | B                        |

#### Calculation of stars for heating and DHW

|                                    |                                                                     |
|------------------------------------|---------------------------------------------------------------------|
| Main heating energy efficiency     | $3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$ , stars = 4   |
| Main heating environmental impact  | $0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$ , stars = 4 |
| Water heating energy efficiency    | $3.48 / 0.8419 = 4.133$ , stars = 4                                 |
| Water heating environmental impact | $0.216 / 0.8419 = 0.2565$ , stars = 4                               |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                   | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                   | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 219.9050 (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                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.1819 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.4319 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3671 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.6000 | 5.1000 | 4.8000 | 4.5000 | 4.7000 | 4.2000 | 4.4000 | 4.2000 | 4.4000 | 4.8000 | 4.9000 | 5.1000 (22)  |
| Wind factor     | 1.4000 | 1.2750 | 1.2000 | 1.1250 | 1.1750 | 1.0500 | 1.1000 | 1.0500 | 1.1000 | 1.2000 | 1.2250 | 1.2750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.5140 | 0.4681 | 0.4405 | 0.4130 | 0.4314 | 0.3855 | 0.4038 | 0.3855 | 0.4038 | 0.4405 | 0.4497 | 0.4681 (22b) |
|                 | 0.6321 | 0.6095 | 0.5970 | 0.5853 | 0.5930 | 0.5743 | 0.5815 | 0.5743 | 0.5815 | 0.5970 | 0.6011 | 0.6095 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 45.8689  | 44.2338  | 43.3261 | 42.4733 | 43.0357 | 41.6756 | 42.2013 | 41.6756 | 42.2013 | 43.3261 | 43.6225 | 44.2338 (38)  |
| Heat transfer coeff       | 102.0878 | 100.4527 | 99.5450 | 98.6923 | 99.2546 | 97.8946 | 98.4203 | 97.8946 | 98.4203 | 99.5450 | 99.8414 | 100.4527 (39) |
| Average = Sum(39)m / 12 = |          |          |         |         |         |         |         |         |         |         |         | 99.3751 (39)  |
| HLP                       | 1.1954   | 1.1763   | 1.1656  | 1.1556  | 1.1622  | 1.1463  | 1.1525  | 1.1463  | 1.1525  | 1.1656  | 1.1691  | 1.1763 (40)   |
| HLP (average)             |          |          |         |         |         |         |         |         |         |         |         | 1.1636 (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                        |          |          |          |          |          |          |         |          |          |          |          | 2.5574 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |          |          | 94.9379 (43)                      |
| Daily hot water use                      | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366  | 100.6341 | 104.4316 (44)                     |
| Energy conte                             | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266 | 138.1136 | 149.9825 (45)                     |
| Energy content (annual)                  |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1493.7422 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790  | 20.7170  | 22.4974 (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)                       |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design  
System) version 4.12r02

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)   |
| Combi loss                                                      | 50.9589  | 46.0274  | 49.3469  | 45.8823  | 45.4765  | 42.1368  | 43.5414  | 45.4765  | 45.8823  | 49.3469  | 49.3151  | 50.9589 (61)  |
| Total heat required for water heating calculated for each month | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 (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                                                 | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 (64) |
| Heat gains from water heating, kWh/month                        | 64.2337  | 56.5438  | 58.8108  | 51.9878  | 50.2464  | 44.0823  | 41.9726  | 47.0422  | 47.5697  | 54.4068  | 58.2516  | 62.6089 (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                                                                               | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 53.9952   | 47.9580   | 39.0021   | 29.0718   | 22.0718   | 18.6340   | 20.1347   | 26.1718   | 35.1278   | 44.6028   | 52.0580   | 55.4959 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 343.8150  | 347.3828  | 338.3922  | 319.2524  | 295.0918  | 272.3843  | 257.2143  | 253.6465  | 262.6371  | 281.7769  | 305.9375  | 328.6450 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017 (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 (71) |
| Water heating gains (Table 5)                                                       | 86.3356   | 84.1426   | 79.0468   | 72.2053   | 67.5355   | 61.2255   | 56.4148   | 63.2288   | 66.0691   | 73.1274   | 80.9049   | 84.1517 (72)   |
| Total internal gains                                                                | 591.1952  | 586.5327  | 563.4905  | 528.0342  | 491.7485  | 459.2931  | 440.8131  | 450.0965  | 470.8833  | 506.5564  | 545.9498  | 575.3420 (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    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|----------|------------------------------|----------|---------------|
| East        |          |          |          | 4.0700     | 27.3735                        |           | 0.7100                            | 0.7000                             |          | 0.7700                       |          | 38.3719 (76)  |
| South       |          |          |          | 1.8000     | 61.3950                        |           | 0.7100                            | 0.7000                             |          | 0.7700                       |          | 38.0623 (78)  |
| West        |          |          |          | 7.2600     | 27.3735                        |           | 0.7100                            | 0.7000                             |          | 0.7700                       |          | 68.4473 (80)  |
|             |          |          |          |            |                                |           |                                   |                                    |          |                              |          |               |
| Solar gains | 144.8815 | 226.0542 | 351.4120 | 508.4008   | 588.0733                       | 641.2775  | 608.7097                          | 534.4776                           | 430.1811 | 282.2260                     | 170.8627 | 117.1685 (83) |
| Total gains | 736.0767 | 812.5870 | 914.9025 | 1036.4349  | 1079.8218                      | 1100.5706 | 1049.5228                         | 984.5741                           | 901.0644 | 788.7824                     | 716.8124 | 692.5105 (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                                                                         | 58.0927 | 59.0383 | 59.5766 | 60.0914 | 59.7509 | 60.5810 | 60.2575 | 60.5810 | 60.2575 | 59.5766 | 59.3997 | 59.0383      |
| alpha                                                                       | 4.8728  | 4.9359  | 4.9718  | 5.0061  | 4.9834  | 5.0387  | 5.0172  | 5.0387  | 5.0172  | 4.9718  | 4.9600  | 4.9359       |
| util living area                                                            | 0.9859  | 0.9776  | 0.9475  | 0.8591  | 0.6918  | 0.4740  | 0.3274  | 0.3273  | 0.5720  | 0.8604  | 0.9670  | 0.9882 (86)  |
| MIT                                                                         | 20.0991 | 20.2203 | 20.4770 | 20.7639 | 20.9375 | 20.9924 | 20.9990 | 20.9991 | 20.9823 | 20.8163 | 20.4467 | 20.0999 (87) |
| Th 2                                                                        | 19.9237 | 19.9390 | 19.9476 | 19.9556 | 19.9503 | 19.9632 | 19.9582 | 19.9632 | 19.9582 | 19.9476 | 19.9448 | 19.9390 (88) |
| util rest of house                                                          | 0.9811  | 0.9702  | 0.9308  | 0.8192  | 0.6197  | 0.3861  | 0.2304  | 0.2249  | 0.4699  | 0.8057  | 0.9538  | 0.9841 (89)  |
| MIT 2                                                                       | 18.7740 | 18.9583 | 19.3252 | 19.7091 | 19.9011 | 19.9596 | 19.9580 | 19.9630 | 19.9494 | 19.7776 | 19.2882 | 18.7869 (90) |
| Living area fraction                                                        | 19.0823 | 19.2519 | 19.5932 | 19.9545 | 20.1422 | 20.1999 | 20.2002 | 20.2041 | 20.1897 | 20.0193 | 19.5577 | 19.0924 (92) |
| Temperature adjustment                                                      | 18.9323 | 19.1019 | 19.4432 | 19.8045 | 19.9922 | 20.0499 | 20.0502 | 20.0541 | 20.0397 | 19.8693 | 19.4077 | 18.9424 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |           |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
| Useful gains         | 0.9750    | 0.9625    | 0.9208    | 0.8127   | 0.6227   | 0.3936   | 0.2390   | 0.2339   | 0.4782   | 0.8010   | 0.9448    | 0.9786 (94)    |
| Ext temp.            | 717.6590  | 782.0764  | 842.4095  | 842.2676 | 672.4469 | 433.1456 | 250.8497 | 230.3373 | 430.9192 | 631.7851 | 677.2337  | 677.7092 (95)  |
| Heat loss rate W     | 5.8000    | 6.0000    | 7.5000    | 9.8000   | 12.9000  | 15.6000  | 17.5000  | 17.7000  | 15.6000  | 12.5000  | 9.0000    | 6.0000 (96)    |
| Month fracti         | 1340.6514 | 1316.1198 | 1188.8817 | 987.3716 | 703.9366 | 435.6217 | 250.9955 | 230.4546 | 436.9579 | 733.5762 | 1039.1216 | 1300.0999 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating per m2 | 463.5063  | 358.8772  | 257.7753  | 104.4749 | 23.4283  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 75.7325  | 260.5593  | 463.0587 (98)  |
|                      |           |           |           |          |          |          |          |          |          |          |           | 2007.4126 (98) |
|                      |           |           |           |          |          |          |          |          |          |          |           | 23.5060 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

|                                                                       |          |          |          |          |          |          |          |          |          |           |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |           |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |           |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |           |          |           | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |           |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |           |          |           | 2218.1354 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov      | Dec       |                 |
| Space heating requirement                                             | 463.5063 | 358.8772 | 257.7753 | 104.4749 | 23.4283  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 75.7325   | 260.5593 | 463.0587  | (98)            |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 90.5000   | 90.5000  | 90.5000   | (210)           |
| Space heating fuel (main heating system)                              | 512.1617 | 396.5493 | 284.8346 | 115.4419 | 25.8877  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 83.6823   | 287.9109 | 511.6670  | (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                                             | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007 | 143.0334 | 137.0369 | 152.7641 | 154.4512 | 175.8734  | 187.4287 | 200.9414  | (64)            |
| Efficiency of water heater (217)m                                     | 87.1340  | 86.8364  | 85.9318  | 83.9978  | 81.5474  | 80.4000  | 80.4000  | 80.4000  | 80.4000  | 83.1947   | 85.9810  | 87.1856   | (216)           |
| Fuel for water heating, kWh/month                                     | 236.2201 | 208.9872 | 220.0800 | 199.6941 | 199.1488 | 177.9023 | 170.4439 | 190.0050 | 192.1035 | 211.3999  | 217.9884 | 230.4755  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |           |          | 2454.4487 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |           |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |           |          | 2218.1354 | (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)                   |          |          |          |          |          |          |          |          |          |           |          |           | 381.4286 (232)  |
| Energy saving/generation technologies (Appendices M, N and Q)         |          |          |          |          |          |          |          |          |          |           |          |           |                 |
| PV Unit 0 (0.80 * 1.10 * 1118 * 0.80) =                               |          |          |          |          |          |          |          |          |          | -787.3456 |          | -787.3456 | (233)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |           |          |           | 4341.6673 (238) |

#### 10a. Fuel costs - using BEDF prices (454)

|                                       | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1         | 2218.1354        | 3.9700              | 88.0600 (240)       |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 2454.4487        | 3.9700              | 97.4416 (247)       |
| Pumps and fans for heating            | 75.0000          | 18.2700             | 13.7025 (249)       |
| Energy for lighting                   | 381.4286         | 18.2700             | 69.6870 (250)       |
| Additional standing charges           |                  |                     | 90.0000 (251)       |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | -787.3456        | 18.2700             | -143.8480 (252)     |
| Total energy cost                     |                  |                     | 215.0431 (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         | 2218.1354          | 0.2160                        | 479.1173 (261)           |
| Space heating - secondary             | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)            | 2454.4487          | 0.2160                        | 530.1609 (264)           |
| Space and water heating               |                    |                               | 1009.2782 (265)          |
| Pumps and fans                        | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                   | 381.4286           | 0.5190                        | 197.9615 (268)           |
| Energy saving/generation technologies |                    |                               |                          |
| PV Unit                               | -787.3456          | 0.5190                        | -408.6323 (269)          |
| Total kg/year                         |                    |                               | 837.5323 (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         | 2218.1354          | 1.2200                              | 2706.1252 (261)            |
| Space heating - secondary             | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)            | 2454.4487          | 1.2200                              | 2994.4274 (264)            |
| Space and water heating               |                    |                                     | 5700.5527 (265)            |
| Pumps and fans                        | 75.0000            | 3.0700                              | 230.2500 (267)             |
| Energy for lighting                   | 381.4286           | 3.0700                              | 1170.9859 (268)            |
| Energy saving/generation technologies |                    |                                     |                            |
| PV Unit                               | -787.3456          | 3.0700                              | -2417.1509 (269)           |
| Primary energy kWh/year               |                    |                                     | 4684.6377 (272)            |
| Primary energy kWh/m2/year            |                    |                                     | 54.8552 (273)              |

#### SAP 2012 EPC IMPROVEMENTS

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

Current energy efficiency rating: B 87  
Current environmental impact rating: B 89

|                         |                           |                   |
|-------------------------|---------------------------|-------------------|
| (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      | -£ 35       | -214 kg (25.6%) |

| Recommended measures | Typical annual savings | Energy efficiency | Environmental impact |
|----------------------|------------------------|-------------------|----------------------|
| Solar water heating  | £35                    | 2.51 kg/m²        | B 89 B 91            |
| Total Savings        | £35                    | 2.51 kg/m²        |                      |

Potential energy efficiency rating: B 89  
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 454 TEST (24 Dec 2019)  
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              | £83        | £93        | -£9        |
| Mains gas                | £276       | £231       | £44        |
| Space heating            | £192       | £192       | £0         |
| Water heating            | £97        | £62        | £35        |
| Lighting                 | £70        | £70        | £0         |
| Generated (PV)           | -£144      | -£144      | £0         |
| Total cost of fuels      | £215       | £180       | £35        |
| Total cost of uses       | £215       | £180       | £35        |
| Delivered energy         | 51 kWh/m²  | 38 kWh/m²  | 12 kWh/m²  |
| Carbon dioxide emissions | 0.8 tonnes | 0.6 tonnes | 0.2 tonnes |
| CO2 emissions per m²     | 10 kg/m²   | 7 kg/m²    | 3 kg/m²    |
| Primary energy           | 55 kWh/m²  | 41 kWh/m²  | 14 kWh/m²  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                     | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                     | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 219.9050 (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                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.1819 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.4319 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3671 (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 | 0.4681 | 0.4589 | 0.4497 | 0.4038 | 0.3946 | 0.3488 | 0.3488 | 0.3396 | 0.3671 | 0.3946 | 0.4130 | 0.4314 (22b) |
| Effective ac    | 0.6095 | 0.6053 | 0.6011 | 0.5615 | 0.5779 | 0.5608 | 0.5608 | 0.5577 | 0.5674 | 0.5779 | 0.5853 | 0.5930 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 44.2338  | 43.9251  | 43.6225 | 42.2013 | 41.9354 | 40.6976 | 40.6976 | 40.4684 | 41.1744 | 41.9354 | 42.4733 | 43.0357 (38) |
| Heat transfer coeff       | 100.4527 | 100.1440 | 99.8414 | 98.4203 | 98.1544 | 96.9166 | 96.9166 | 96.6873 | 97.3933 | 98.1544 | 98.6923 | 99.2546 (39) |
| Average = Sum(39)m / 12 = |          |          |         |         |         |         |         |         |         |         |         | 98.4190 (39) |
| HLP                       | 1.1763   | 1.1726   | 1.1691  | 1.1525  | 1.1493  | 1.1349  | 1.1349  | 1.1322  | 1.1404  | 1.1493  | 1.1556  | 1.1622 (40)  |
| HLP (average)             |          |          |         |         |         |         |         |         |         |         |         | 1.1524 (40)  |
| Days in month             | 31       | 28       | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

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

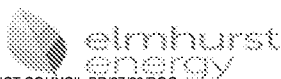
|                                          |          |          |          |          |          |          |         |          |          |          |          |                                   |
|------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Assumed occupancy                        |          |          |          |          |          |          |         |          |          |          |          | 2.5574 (42)                       |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |          |          | 94.9379 (43)                      |
| Daily hot water use                      | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366  | 100.6341 | 104.4316 (44)                     |
| Energy conte                             | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266 | 138.1136 | 149.9825 (45)                     |
| Energy content (annual)                  |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1493.7422 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790  | 20.7170  | 22.4974 (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)                       |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

|                                                                 |          |          |          |          |           |           |           |          |          |          |          |          |                 |
|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------------|
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)     |
| Combi loss                                                      | 50.9589  | 46.0274  | 49.3469  | 45.8823  | 45.4765   | 42.1368   | 43.5414   | 45.4765  | 45.8823  | 49.3469  | 49.3151  | 50.9589  | (61)            |
| Total heat required for water heating calculated for each month | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007  | 143.0334  | 137.0369  | 152.7641 | 154.4512 | 175.8734 | 187.4287 | 200.9414 | (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                                             |          |          |          |          |           |           |           |          |          |          |          |          | 1.2141 (H8)     |
| Utilisation factor                                              |          |          |          |          |           |           |           |          |          |          |          |          | 0.5612 (H9)     |
| Collector performance factor                                    |          |          |          |          |           |           |           |          |          |          |          |          | 0.8793 (H10)    |
| Dedicated solar storage volume                                  |          |          |          |          |           |           |           |          |          |          |          |          | 75.0000 (H11)   |
| Effective solar volume                                          |          |          |          |          |           |           |           |          |          |          |          |          | 75.0000 (H13)   |
| Daily hot water demand                                          |          |          |          |          |           |           |           |          |          |          |          |          | 94.9379 (H14)   |
| Volume ratio Veff/V                                             |          |          |          |          |           |           |           |          |          |          |          |          | 0.7900 (H15)    |
| Solar storage volume factor                                     |          |          |          |          |           |           |           |          |          |          |          |          | 0.9529 (H16)    |
| Solar input                                                     |          |          |          |          |           |           |           |          |          |          |          |          | -852.6929 (H17) |
| Solar input                                                     | -24.7264 | -41.2612 | -70.2726 | -94.1792 | -116.3504 | -114.3910 | -112.8793 | -98.6232 | -77.2417 | -52.7470 | -29.3291 | -20.6918 | (63)            |
|                                                                 |          |          |          |          |           |           |           |          |          |          |          |          | -852.6929 (63)  |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |           |           |           |          |          |          |          |          |                 |
| Output from w/h                                                 | 181.1016 | 140.2157 | 118.8460 | 73.5595  | 46.0502   | 28.6424   | 24.1576   | 54.1409  | 77.2094  | 123.1264 | 158.0996 | 180.2496 | (64)            |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |           |           |           |          |          |          |          |          | 1205.3991 (64)  |
| Heat gains from water heating, kWh/month                        | 64.2337  | 56.5438  | 58.8108  | 51.9878  | 50.2464   | 44.0823   | 41.9726   | 47.0422  | 47.5697  | 54.4068  | 58.2516  | 62.6089  | (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                                                                               | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 53.9952   | 47.9580   | 39.0021   | 29.5271   | 22.0718   | 18.6340   | 20.1347   | 26.1718   | 35.1278   | 44.6028   | 52.0580   | 55.4959   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 343.8150  | 347.3828  | 338.3922  | 319.2524  | 295.0918  | 272.3843  | 257.2143  | 253.6465  | 262.6371  | 281.7769  | 305.9375  | 328.6450  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | (71) |
| Water heating gains (Table 5)                                                       | 86.3356   | 84.1426   | 79.0468   | 72.2053   | 67.5355   | 61.2255   | 56.4148   | 63.2288   | 66.0691   | 73.1274   | 80.9049   | 84.1517   | (72) |
| Total internal gains                                                                | 591.1952  | 586.5327  | 563.4905  | 528.0342  | 491.7485  | 459.2931  | 440.8131  | 450.0965  | 470.8833  | 506.5564  | 545.9498  | 575.3420  | (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   |          |          |          |      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|------|
| East        |          |          |          | 4.0700     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       | 27.5316 (76) |          |          |          |      |
| South       |          |          |          | 1.8000     | 46.7521                        | 0.7100                            | 0.7000                             | 0.7700                       | 28.9843 (78) |          |          |          |      |
| West        |          |          |          | 7.2600     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       | 49.1104 (80) |          |          |          |      |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |          |      |
| Solar gains | 105.6263 | 197.3968 | 307.3770 | 428.4443   | 512.5358                       | 520.3051                          | 497.0664                           | 434.4828                     | 350.3314     | 229.1018 | 129.9199 | 88.0718  | (83) |
| Total gains | 696.8215 | 783.9296 | 870.8674 | 956.4785   | 1004.2843                      | 979.5981                          | 937.8795                           | 884.5793                     | 821.2147     | 735.6582 | 675.8696 | 663.4137 | (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                                                                         | 59.0383 | 59.2203 | 59.3997 | 60.2575 | 60.4207 | 61.1924 | 61.1924 | 61.3375 | 60.8928 | 60.4207 | 60.0914 | 59.7509 |              |
| alpha                                                                       | 4.9359  | 4.9480  | 4.9600  | 5.0172  | 5.0280  | 5.0795  | 5.0795  | 5.0892  | 5.0595  | 5.0280  | 5.0061  | 4.9834  |              |
| util living area                                                            | 0.9923  | 0.9853  | 0.9663  | 0.9105  | 0.7919  | 0.6089  | 0.4501  | 0.4951  | 0.7417  | 0.9375  | 0.9851  | 0.9939  | (86)         |
| MIT                                                                         | 19.9207 | 20.0801 | 20.3357 | 20.6483 | 20.8707 | 20.9737 | 20.9953 | 20.9925 | 20.9307 | 20.6358 | 20.2244 | 19.8938 | (87)         |
| Th 2                                                                        | 19.9390 | 19.9419 | 19.9448 | 19.9582 | 19.9607 | 19.9725 | 19.9725 | 19.9746 | 19.9679 | 19.9607 | 19.9556 | 19.9503 | (88)         |
| util rest of house                                                          | 0.9899  | 0.9807  | 0.9556  | 0.8827  | 0.7342  | 0.5213  | 0.3474  | 0.3887  | 0.6579  | 0.9117  | 0.9796  | 0.9919  | (89)         |
| MIT 2                                                                       | 18.5264 | 18.7588 | 19.1259 | 19.5653 | 19.8423 | 19.9562 | 19.9708 | 19.9718 | 19.9176 | 19.5611 | 18.9794 | 18.4955 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         | 0.2327 (91)  |
| MIT                                                                         | 18.8508 | 19.0662 | 19.4074 | 19.8172 | 20.0816 | 20.1930 | 20.2092 | 20.2093 | 20.1533 | 19.8111 | 19.2691 | 18.8208 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |         | -0.1500      |
| adjusted MIT                                                                | 18.7008 | 18.9162 | 19.2574 | 19.6672 | 19.9316 | 20.0430 | 20.0592 | 20.0593 | 20.0033 | 19.6611 | 19.1191 | 18.6708 | (93)         |

#### 8. Space heating requirement

|             |        |        |        |        |        |        |        |        |        |        |        |        |      |
|-------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| Utilisation | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
|             | 0.9857 | 0.9745 | 0.9465 | 0.8734 | 0.7324 | 0.5275 | 0.3562 | 0.3977 | 0.6610 | 0.9023 | 0.9733 | 0.9884 | (94) |

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|                      |           |           |           |           |          |          |          |          |          |          |              |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------------|
| Useful gains         | 686.8759  | 763.9186  | 824.2460  | 835.4340  | 735.5388 | 516.7700 | 334.0928 | 351.7958 | 542.8474 | 663.7915 | 657.8531     | 655.7363 (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     | 1446.6008 | 1403.6412 | 1273.7153 | 1059.7154 | 807.9692 | 527.5141 | 335.2535 | 353.8060 | 574.9392 | 889.3900 | 1186.1931    | 1436.2984 (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    | 565.2353  | 429.8935  | 334.4052  | 161.4826  | 53.8882  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 167.8453 | 380.4048     | 580.7382 (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |              | 2673.8931 (98) |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          | (98) / (4) = | 31.3102 (99)   |

#### 8c. Space cooling requirement

Not applicable

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

|                                                                       |          |          |          |          |         |         |         |         |           |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|-----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |         |         |         |         |           |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |         |         |         |         |           |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |         |         |         |         |           |          |          | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |         |         |         |         |           |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |         |         |         |         |           |          |          | 2954.5780 (211) |
| Jan                                                                   | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct       | Nov      | Dec      |                 |
| Space heating requirement                                             | 565.2353 | 429.8935 | 334.4052 | 161.4826 | 53.8882 | 0.0000  | 0.0000  | 0.0000  | 0.0000    | 167.8453 | 380.4048 | 580.7382 (98)   |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000 | 0.0000  | 0.0000  | 0.0000  | 0.0000    | 90.5000  | 90.5000  | 90.5000 (210)   |
| Space heating fuel (main heating system)                              | 624.5694 | 475.0205 | 369.5085 | 178.4338 | 59.5449 | 0.0000  | 0.0000  | 0.0000  | 0.0000    | 185.4644 | 420.3368 | 641.6996 (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                                             | 181.1016 | 140.2157 | 118.8460 | 73.5595  | 46.0502 | 28.6424 | 24.1576 | 54.1409 | 77.2094   | 123.1264 | 158.0996 | 180.2496 (64)   |
| Efficiency of water heater                                            | 87.8229  | 87.7877  | 87.6141  | 87.0766  | 85.5481 | 80.4000 | 80.4000 | 80.4000 | 80.4000   | 85.9321  | 87.2810  | 80.4000 (216)   |
| (217)m                                                                | 87.8229  | 87.7877  | 87.6141  | 87.0766  | 85.5481 | 80.4000 | 80.4000 | 80.4000 | 80.4000   | 85.9321  | 87.2810  | 87.8850 (217)   |
| Fuel for water heating, kWh/month                                     | 206.2122 | 159.7213 | 135.6472 | 84.4768  | 53.8297 | 35.6249 | 30.0468 | 67.3394 | 96.0316   | 143.2835 | 181.1387 | 205.0972 (219)  |
| Water heating fuel used                                               |          |          |          |          |         |         |         |         |           |          |          | 1398.4494 (219) |
| Annual totals kWh/year                                                |          |          |          |          |         |         |         |         |           |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |         |         |         |         |           |          |          | 2954.5780 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |         |         |         |         |           |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |         |         |         |         |           |          |          |                 |
| central heating pump                                                  |          |          |          |          |         |         |         |         |           |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |         |         |         |         |           |          |          | 45.0000 (230e)  |
| pump for solar water heating                                          |          |          |          |          |         |         |         |         |           |          |          | 50.0000 (230g)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |         |         |         |         |           |          |          | 125.0000 (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |         |         |         |         |           |          |          | 381.4286 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |         |         |         |         |           |          |          |                 |
| PV Unit 0 (0.80 * 1.10 * 908 * 0.80) =                                |          |          |          |          |         |         |         |         | -639.1294 |          |          | -639.1294 (233) |
| Total delivered energy for all uses                                   |          |          |          |          |         |         |         |         |           |          |          | 4220.3266 (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         | 2954.5780        | 3.4800              | 102.8193 (240)      |
| Space heating - secondary             | 0.0000           | 0.0000              | 0.0000 (242)        |
| Water heating (other fuel)            | 1398.4494        | 3.4800              | 48.6660 (247)       |
| Pumps and fans for heating            | 75.0000          | 13.1900             | 9.8925 (249)        |
| Pump for solar water heating          | 50.0000          | 13.1900             | 6.5950 (249)        |
| Energy for lighting                   | 381.4286         | 13.1900             | 50.3104 (250)       |
| Additional standing charges           |                  |                     | 120.0000 (251)      |
| Energy saving/generation technologies |                  |                     |                     |
| PV Unit                               | -639.1294        | 13.1900             | -84.3012 (252)      |
| Total energy cost                     |                  |                     | 253.9821 (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] = | 0.8180 (257) |
| SAP value                        |                                  | 88.5883      |
| SAP rating (Section 12)          |                                  | 89 (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 | 2954.5780          | 0.2160                        | 638.1888 (261)           |
| Space heating - secondary     | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)    | 1398.4494          | 0.2160                        | 302.0651 (264)           |
| Space and water heating       |                    |                               | 940.2539 (265)           |

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|                                       |           |        |                 |
|---------------------------------------|-----------|--------|-----------------|
| Pumps and fans                        | 125.0000  | 0.5190 | 64.8750 (267)   |
| Energy for lighting                   | 381.4286  | 0.5190 | 197.9615 (268)  |
| Energy saving/generation technologies |           |        |                 |
| PV Unit                               |           |        |                 |
| Total kg/year                         | -639.1294 | 0.5190 | -331.7082 (269) |
| CO2 emissions per m2                  |           |        | 871.3822 (272)  |
| EI value                              |           |        | 10.2000 (273)   |
| EI rating                             |           |        | 91.0456         |
| EI band                               |           |        | 91 (274)        |
|                                       |           |        | B               |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

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

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 42.7000 (1b)              | x 2.3900 (2b)                   | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                   | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 219.9050 (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                                             |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                 |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                            |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) |                 |                      |       |                             | 40.0000 / (5) = 0.1819 (8) |
| Pressure test                                                           |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                    |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                       |                 |                      |       |                             | 0.4319 (18)                |
| Number of sides sheltered                                               |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                          |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                    |                 |                      |       | (21) = (18) x (20) =        | 0.3671 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.6000 | 5.1000 | 4.8000 | 4.5000 | 4.7000 | 4.2000 | 4.4000 | 4.2000 | 4.4000 | 4.8000 | 4.9000 | 5.1000 (22)  |
| Wind factor     | 1.4000 | 1.2750 | 1.2000 | 1.1250 | 1.1750 | 1.0500 | 1.1000 | 1.0500 | 1.1000 | 1.2000 | 1.2250 | 1.2750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.5140 | 0.4681 | 0.4405 | 0.4130 | 0.4314 | 0.3855 | 0.4038 | 0.3855 | 0.4038 | 0.4405 | 0.4497 | 0.4681 (22b) |
|                 | 0.6321 | 0.6095 | 0.5970 | 0.5853 | 0.5930 | 0.5743 | 0.5815 | 0.5743 | 0.5815 | 0.5970 | 0.6011 | 0.6095 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 45.8689  | 44.2338  | 43.3261 | 42.4733 | 43.0357 | 41.6756 | 42.2013 | 41.6756 | 42.2013 | 43.3261 | 43.6225 | 44.2338 (38)  |
| Heat transfer coeff       | 102.0878 | 100.4527 | 99.5450 | 98.6923 | 99.2546 | 97.8946 | 98.4203 | 97.8946 | 98.4203 | 99.5450 | 99.8414 | 100.4527 (39) |
| Average = Sum(39)m / 12 = |          |          |         |         |         |         |         |         |         |         |         | 99.3751 (39)  |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1954 | 1.1763 | 1.1656 | 1.1556 | 1.1622 | 1.1463 | 1.1525 | 1.1463 | 1.1525 | 1.1656 | 1.1691 | 1.1763 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1636 (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                        |          |          |          |          |          |          |         |          |          |          |          | 2.5574 (42)                       |
|------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |          |          | 94.9379 (43)                      |
|                                          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Daily hot water use                      | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366  | 100.6341 | 104.4316 (44)                     |
| Energy conte                             | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266 | 138.1136 | 149.9825 (45)                     |
| Energy content (annual)                  |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1493.7422 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790  | 20.7170  | 22.4974 (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)                       |

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|                                                                 |          |          |          |          |           |           |           |           |          |          |          |           |       |
|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|----------|----------|-----------|-------|
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (57)  |
| Combi loss                                                      | 50.9589  | 46.0274  | 49.3469  | 45.8823  | 45.4765   | 42.1368   | 43.5414   | 45.4765   | 45.8823  | 49.3469  | 49.3151  | 50.9589   | (61)  |
| Total heat required for water heating calculated for each month | 205.8280 | 181.4769 | 189.1186 | 167.7387 | 162.4007  | 143.0334  | 137.0369  | 152.7641  | 154.4512 | 175.8734 | 187.4287 | 200.9414  | (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                                   |          |          |          |          |           |           |           |           |          |          |          | 1306.9326 | (H5)  |
| Overshading factor                                              |          |          |          |          |           |           |           |           |          |          |          | 0.8000    | (H6)  |
| Solar energy available                                          |          |          |          |          |           |           |           |           |          |          |          | 2195.6468 | (H7)  |
| Adjustment factor for showers                                   |          |          |          |          |           |           |           |           |          |          |          | 1.0000    | (H7a) |
| Solar-to-load ratio                                             |          |          |          |          |           |           |           |           |          |          |          | 1.4699    | (H8)  |
| Utilisation factor                                              |          |          |          |          |           |           |           |           |          |          |          | 0.4935    | (H9)  |
| Collector performance factor                                    |          |          |          |          |           |           |           |           |          |          |          | 0.8793    | (H10) |
| Dedicated solar storage volume                                  |          |          |          |          |           |           |           |           |          |          |          | 75.0000   | (H11) |
| Effective solar volume                                          |          |          |          |          |           |           |           |           |          |          |          | 75.0000   | (H13) |
| Daily hot water demand                                          |          |          |          |          |           |           |           |           |          |          |          | 94.9379   | (H14) |
| Volume ratio Veff/V                                             |          |          |          |          |           |           |           |           |          |          |          | 0.7900    | (H15) |
| Solar storage volume factor                                     |          |          |          |          |           |           |           |           |          |          |          | 0.9529    | (H16) |
| Solar input                                                     |          |          |          |          |           |           |           |           |          |          |          | -907.9231 | (H17) |
| Solar input                                                     | -29.7065 | -41.4139 | -70.5090 | -98.2350 | -117.4605 | -124.0869 | -121.6481 | -106.6933 | -83.2954 | -56.9762 | -33.7900 | -24.1083  | (63)  |
|                                                                 |          |          |          |          |           |           |           |           |          |          |          | -907.9231 | (63)  |
|                                                                 |          |          |          |          |           |           |           |           |          |          |          |           |       |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |           |           |           |           |          |          |          |           |       |
| Output from w/h                                                 | 176.1215 | 140.0630 | 118.6096 | 69.5037  | 44.9402   | 18.9465   | 15.3888   | 46.0708   | 71.1558  | 118.8973 | 153.6387 | 176.8331  | (64)  |
|                                                                 |          |          |          |          |           |           |           |           |          |          |          |           |       |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |           |           |           |           |          |          |          | 1150.1690 | (64)  |
| Heat gains from water heating, kWh/month                        | 64.2337  | 56.5438  | 58.8108  | 51.9878  | 50.2464   | 44.0823   | 41.9726   | 47.0422   | 47.5697  | 54.4068  | 58.2516  | 62.6089   | (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                                                                               | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | 153.4430  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 53.9952   | 47.9580   | 39.0021   | 29.5271   | 22.0718   | 18.6340   | 20.1347   | 26.1718   | 35.1278   | 44.6028   | 52.0580   | 55.4959   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 343.8150  | 347.3828  | 338.3922  | 319.2524  | 295.0918  | 272.3843  | 257.2143  | 253.6465  | 262.6371  | 281.7769  | 305.9375  | 328.6450  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | 52.9017   | (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | (71) |
| Water heating gains (Table 5)                                                       | 86.3356   | 84.1426   | 79.0468   | 72.2053   | 67.5355   | 61.2255   | 56.4148   | 63.2288   | 66.0691   | 73.1274   | 80.9049   | 84.1517   | (72) |
| Total internal gains                                                                | 591.1952  | 586.5327  | 563.4905  | 528.0342  | 491.7485  | 459.2931  | 440.8131  | 450.0965  | 470.8833  | 506.5564  | 545.9498  | 575.3420  | (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   |      |
|-------------|----------|----------|----------|-----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|------|
| East        |          |          |          |           | 4.0700     | 27.3735                        |           | 0.7100                            | 0.7000                             | 0.7700                       |          | 38.3719 (76) |      |
| South       |          |          |          |           | 1.8000     | 61.3950                        |           | 0.7100                            | 0.7000                             | 0.7700                       |          | 38.0623 (78) |      |
| West        |          |          |          |           | 7.2600     | 27.3735                        |           | 0.7100                            | 0.7000                             | 0.7700                       |          | 68.4473 (80) |      |
|             |          |          |          |           |            |                                |           |                                   |                                    |                              |          |              |      |
| Solar gains | 144.8815 | 226.0542 | 351.4120 | 508.4008  | 588.0733   | 641.2775                       | 608.7097  | 534.4776                          | 430.1811                           | 282.2260                     | 170.8627 | 117.1685     | (83) |
| Total gains | 736.0767 | 812.5870 | 914.9025 | 1036.4349 | 1079.8218  | 1100.5706                      | 1049.5228 | 984.5741                          | 901.0644                           | 788.7824                     | 716.8124 | 692.5105     | (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                                                                         | 58.0927 | 59.0383 | 59.5766 | 60.0914 | 59.7509 | 60.5810 | 60.2575 | 60.5810 | 60.2575 | 59.5766 | 59.3997 | 59.0383 |              |
| alpha                                                                       | 4.8728  | 4.9359  | 4.9718  | 5.0061  | 4.9834  | 5.0387  | 5.0172  | 5.0387  | 5.0172  | 4.9718  | 4.9600  | 4.9359  |              |
| util living area                                                            | 0.9859  | 0.9776  | 0.9475  | 0.8591  | 0.6918  | 0.4740  | 0.3274  | 0.3273  | 0.5720  | 0.8604  | 0.9670  | 0.9882  | (86)         |
| MIT                                                                         | 20.0991 | 20.2203 | 20.4770 | 20.7639 | 20.9375 | 20.9924 | 20.9990 | 20.9991 | 20.9823 | 20.8163 | 20.4467 | 20.0999 | (87)         |
| Th 2                                                                        | 19.9237 | 19.9390 | 19.9476 | 19.9556 | 19.9503 | 19.9632 | 19.9582 | 19.9632 | 19.9582 | 19.9476 | 19.9448 | 19.9390 | (88)         |
| util rest of house                                                          | 0.9811  | 0.9702  | 0.9308  | 0.8192  | 0.6197  | 0.3861  | 0.2304  | 0.2249  | 0.4699  | 0.8057  | 0.9538  | 0.9841  | (89)         |
| MIT 2                                                                       | 18.7740 | 18.9583 | 19.3252 | 19.7091 | 19.9011 | 19.9596 | 19.9580 | 19.9630 | 19.9494 | 19.7776 | 19.2882 | 18.7869 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |         | (91)         |
| MIT                                                                         | 19.0823 | 19.2519 | 19.5932 | 19.9545 | 20.1422 | 20.1999 | 20.2002 | 20.2041 | 20.1897 | 20.0193 | 19.5577 | 19.0924 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | -0.1500 |              |
| adjusted MIT                                                                | 18.9323 | 19.1019 | 19.4432 | 19.8045 | 19.9922 | 20.0499 | 20.0502 | 20.0541 | 20.0397 | 19.8693 | 19.4077 | 18.9424 | (93)         |

#### 8. Space heating requirement

|             |        |        |        |        |        |        |        |        |        |        |        |        |      |
|-------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| Utilisation | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
|             | 0.9750 | 0.9625 | 0.9208 | 0.8127 | 0.6227 | 0.3936 | 0.2390 | 0.2339 | 0.4782 | 0.8010 | 0.9448 | 0.9786 | (94) |

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.1202

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

|                      |           |           |           |          |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Useful gains         | 717.6590  | 782.0764  | 842.4095  | 842.2676 | 672.4469 | 433.1456 | 250.8497 | 230.3373 | 430.9192 | 631.7851     | 677.2337  | 677.7092 (95)  |
| Ext temp.            | 5.8000    | 6.0000    | 7.5000    | 9.8000   | 12.9000  | 15.6000  | 17.5000  | 17.7000  | 15.6000  | 12.5000      | 9.0000    | 6.0000 (96)    |
| Heat loss rate W     | 1340.6514 | 1316.1198 | 1188.8817 | 987.3716 | 703.9366 | 435.6217 | 250.9955 | 230.4546 | 436.9579 | 733.5762     | 1039.1216 | 1300.0999 (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    | 463.5063  | 358.8772  | 257.7753  | 104.4749 | 23.4283  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 75.7325      | 260.5593  | 463.0587 (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |              |           | 2007.4126 (98) |
| Space heating per m2 |           |           |           |          |          |          |          |          |          | (98) / (4) = |           | 23.5060 (99)   |

#### 8c. Space cooling requirement

Not applicable

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

|                                                                       |          |          |          |          |         |         |         |         |         |           |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|-----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |         |         |         |         |         |           |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |         |         |         |         |         |           |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |         |         |         |         |         |           |          | 90.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |         |         |         |         |         |           |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |         |         |         |         |         |           |          | 2218.1354 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct       | Nov      | Dec             |
| Space heating requirement                                             | 463.5063 | 358.8772 | 257.7753 | 104.4749 | 23.4283 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 75.7325   | 260.5593 | 463.0587 (98)   |
| Space heating efficiency (main heating system 1)                      | 90.5000  | 90.5000  | 90.5000  | 90.5000  | 90.5000 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 90.5000   | 90.5000  | 90.5000 (210)   |
| Space heating fuel (main heating system)                              | 512.1617 | 396.5493 | 284.8346 | 115.4419 | 25.8877 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 83.6823   | 287.9109 | 511.6670 (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                                             | 176.1215 | 140.0630 | 118.6096 | 69.5037  | 44.9402 | 18.9465 | 15.3888 | 46.0708 | 71.1558 | 118.8973  | 153.6387 | 176.8331 (64)   |
| Efficiency of water heater                                            | 87.4743  | 87.4173  | 87.0538  | 86.1753  | 83.5970 | 80.4000 | 80.4000 | 80.4000 | 80.4000 | 84.0499   | 86.4707  | 80.4000 (216)   |
| (217)m                                                                | 87.4743  | 87.4173  | 87.0538  | 86.1753  | 83.5970 | 80.4000 | 80.4000 | 80.4000 | 80.4000 | 84.0499   | 86.4707  | 87.4637 (217)   |
| Fuel for water heating, kWh/month                                     | 201.3409 | 160.2236 | 136.2487 | 80.6538  | 53.7581 | 23.5653 | 19.1403 | 57.3019 | 88.5022 | 141.4603  | 177.6772 | 202.1789 (219)  |
| Water heating fuel used                                               |          |          |          |          |         |         |         |         |         |           |          | 1342.0512 (219) |
| Annual totals kWh/year                                                |          |          |          |          |         |         |         |         |         |           |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |         |         |         |         |         |           |          | 2218.1354 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |         |         |         |         |         |           |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |         |         |         |         |         |           |          |                 |
| central heating pump                                                  |          |          |          |          |         |         |         |         |         |           |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |         |         |         |         |         |           |          | 45.0000 (230e)  |
| pump for solar water heating                                          |          |          |          |          |         |         |         |         |         |           |          | 50.0000 (230g)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |         |         |         |         |         |           |          | 125.0000 (231)  |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |         |         |         |         |         |           |          | 381.4286 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)         |          |          |          |          |         |         |         |         |         |           |          |                 |
| PV Unit 0 (0.80 * 1.10 * 1118 * 0.80) =                               |          |          |          |          |         |         |         |         |         | -787.3456 |          | -787.3456 (233) |
| Total delivered energy for all uses                                   |          |          |          |          |         |         |         |         |         |           |          | 3279.2698 (238) |

#### 10a. Fuel costs - using BEDF prices (454)

|                                       |           |            |                 |
|---------------------------------------|-----------|------------|-----------------|
|                                       | Fuel      | Fuel price | Fuel cost       |
|                                       | kWh/year  | p/kWh      | f/year          |
| Space heating - main system 1         | 2218.1354 | 3.9700     | 88.0600 (240)   |
| Space heating - secondary             | 0.0000    | 0.0000     | 0.0000 (242)    |
| Water heating (other fuel)            | 1342.0512 | 3.9700     | 53.2794 (247)   |
| Pumps and fans for heating            | 75.0000   | 18.2700    | 13.7025 (249)   |
| Pump for solar water heating          | 50.0000   | 18.2700    | 9.1350 (249)    |
| Energy for lighting                   | 381.4286  | 18.2700    | 69.6870 (250)   |
| Additional standing charges           |           |            | 90.0000 (251)   |
| Energy saving/generation technologies |           |            |                 |
| PV Unit                               | -787.3456 | 18.2700    | -143.8480 (252) |
| Total energy cost                     |           |            | 180.0159 (255)  |

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

|                                       |           |                 |                 |
|---------------------------------------|-----------|-----------------|-----------------|
|                                       | Energy    | Emission factor | Emissions       |
|                                       | kWh/year  | kg CO2/kWh      | kg CO2/year     |
| Space heating - main system 1         | 2218.1354 | 0.2160          | 479.1173 (261)  |
| Space heating - secondary             | 0.0000    | 0.0000          | 0.0000 (263)    |
| Water heating (other fuel)            | 1342.0512 | 0.2160          | 289.8831 (264)  |
| Space and water heating               |           |                 | 769.0003 (265)  |
| Pumps and fans                        | 125.0000  | 0.5190          | 64.8750 (267)   |
| Energy for lighting                   | 381.4286  | 0.5190          | 197.9615 (268)  |
| Energy saving/generation technologies |           |                 |                 |
| PV Unit                               | -787.3456 | 0.5190          | -408.6323 (269) |
| Total kg/year                         |           |                 | 623.2044 (272)  |

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

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



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

|                                       | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1         | 2218.1354          | 1.2200                              | 2706.1252 (261)            |
| Space heating - secondary             | 0.0000             | 0.0000                              | 0.0000 (263)               |
| Water heating (other fuel)            | 1342.0512          | 1.2200                              | 1637.3025 (264)            |
| Space and water heating               |                    |                                     | 4343.4278 (265)            |
| Pumps and fans                        | 125.0000           | 3.0700                              | 383.7500 (267)             |
| Energy for lighting                   | 381.4286           | 3.0700                              | 1170.9859 (268)            |
| Energy saving/generation technologies |                    |                                     |                            |
| PV Unit                               | -787.3456          | 3.0700                              | -2417.1509 (269)           |
| Primary energy kWh/year               |                    |                                     | 3481.0128 (272)            |
| Primary energy kWh/m2/year            |                    |                                     | 40.7613 (273)              |

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

#### Overheating Calculation Input Data

|                                           |                          |
|-------------------------------------------|--------------------------|
| Dwelling type                             | SemiDetached House       |
| Number of storeys                         | 2                        |
| Cross ventilation possible                | Yes                      |
| SAP Region                                | Southern England         |
| Front of dwelling faces                   | East                     |
| Overshading                               | Average or unknown       |
| Thermal mass parameter                    | 250.0                    |
| Night ventilation                         | Yes                      |
| Ventilation rate during hot weather (ach) | 4.00 (Windows half open) |

#### Overheating Calculation

|                                          |             |
|------------------------------------------|-------------|
| Summer ventilation heat loss coefficient | 290.27 (P1) |
| Transmission heat loss coefficient       | 56.22 (37)  |
| Summer heat loss coefficient             | 346.49 (P2) |

| Overhangs<br>Orientation | Ratio | Z_overhangs | Overhang type |
|--------------------------|-------|-------------|---------------|
| East                     | 0.000 | 1.000       | None          |
| South                    | 0.000 | 1.000       | None          |
| West                     | 0.000 | 1.000       | None          |

| Solar shading<br>Orientation | Z blinds | Solar access | Z overhangs | Z summer   |
|------------------------------|----------|--------------|-------------|------------|
| East                         | 1.000    | 0.90         | 1.000       | 0.900 (P8) |
| South                        | 1.000    | 0.90         | 1.000       | 0.900 (P8) |
| West                         | 1.000    | 0.90         | 1.000       | 0.900 (P8) |

| [Jul]  | 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 | Shading | Gains<br>W |
|--------|------------|--------------------------------|-----------------------------------|------------------------------------|---------|------------|
| East   | 4.0700     | 125.2818                       | 0.7100                            | 0.7000                             | 0.9000  | 205.2692   |
| South  | 1.8000     | 118.5567                       | 0.7100                            | 0.7000                             | 0.9000  | 85.9092    |
| West   | 7.2600     | 125.2818                       | 0.7100                            | 0.7000                             | 0.9000  | 366.1558   |
| total: |            |                                |                                   |                                    |         | 657.3343   |

|                                                        |                 |            |            |      |
|--------------------------------------------------------|-----------------|------------|------------|------|
| Solar gains                                            | Jun<br>705      | Jul<br>657 | Aug<br>587 | (P3) |
| Internal gains                                         | 456             | 438        | 447        |      |
| Total summer gains                                     | 1161            | 1095       | 1034       | (P5) |
| Summer gain/loss ratio                                 | 3.35            | 3.16       | 2.98       | (P6) |
| Summer external temperature                            | 15.40           | 17.30      | 17.30      |      |
| Thermal mass temperature increment (TMP = 250.0)       | 0.25            | 0.25       | 0.25       |      |
| Threshold temperature                                  | 19.00           | 20.71      | 20.53      | (P7) |
| Likelihood of high internal temperature                | Not significant | Slight     | Slight     |      |
| Assessment of likelihood of high internal temperature: | Slight          |            |            |      |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF STANDARD ENE7 CO2 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                                           | 42.7000 (1b)              | x 2.3900 (2b)                     | = 102.0530 (1b) - (3b)      |
| First floor                                            | 42.7000 (1c)              | x 2.7600 (2c)                     | = 117.8520 (1c) - (3c)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 85.4000                   |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 219.9050 (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                                               |                 |                      |       |                             | 4 * 10 = 40.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | 40.0000 / (5) = 0.1819 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                        |
| Measured/design AP50                                                      |                 |                      |       |                             | 5.0000                     |
| Infiltration rate                                                         |                 |                      |       |                             | 0.4319 (18)                |
| Number of sides sheltered                                                 |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3671 (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 | 0.4681 | 0.4589 | 0.4497 | 0.4038 | 0.3946 | 0.3488 | 0.3488 | 0.3396 | 0.3671 | 0.3946 | 0.4130 | 0.4314 (22b) |
| Effective ac    | 0.6095 | 0.6053 | 0.6011 | 0.5615 | 0.5779 | 0.5608 | 0.5608 | 0.5577 | 0.5674 | 0.5779 | 0.5853 | 0.5930 (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 |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| New Dwelling DG Door                                           |                         |                            | 2.0200                    | 1.4000                        | 2.8280       |                                | (26a)         |
| New Dwelling DG Window (Uw = 1.40)                             |                         |                            | 13.1300                   | 1.3258                        | 17.4072      |                                | (27)          |
| Ground Floor                                                   |                         |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (28a)         |
| External Wall                                                  | 101.3000                | 15.1500                    | 86.1500                   | 0.2400                        | 20.6760      |                                | (29a)         |
| External Roof                                                  | 42.7000                 |                            | 42.7000                   | 0.1100                        | 4.6970       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 186.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 50.3052      |                                | (33)          |
| Party Wall                                                     |                         |                            | 46.4000                   | 0.0000                        | 0.0000       |                                | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.9137 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 56.2189 (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                     | 44.2338  | 43.9251  | 43.6225 | 42.2013 | 41.9354 | 40.6976 | 40.6976 | 40.4684 | 41.1744 | 41.9354 | 42.4733 | 43.0357 (38) |
| Heat transfer coeff       | 100.4527 | 100.1440 | 99.8414 | 98.4203 | 98.1544 | 96.9166 | 96.9166 | 96.6873 | 97.3933 | 98.1544 | 98.6923 | 99.2546 (39) |
| Average = Sum(39)m / 12 = |          |          |         |         |         |         |         |         |         |         |         | 98.4190 (39) |
| HLP                       | 1.1763   | 1.1726   | 1.1691  | 1.1525  | 1.1493  | 1.1349  | 1.1349  | 1.1322  | 1.1404  | 1.1493  | 1.1556  | 1.1622 (40)  |
| HLP (average)             |          |          |         |         |         |         |         |         |         |         |         | 1.1524 (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                        |          |          |          |          |          |          |         |          |          |                    |          | 2.5574 (42)    |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |         |          |          |                    |          | 94.9379 (43)   |
| Daily hot water use                      | 104.4316 | 100.6341 | 96.8366  | 93.0391  | 89.2416  | 85.4441  | 85.4441 | 89.2416  | 93.0391  | 96.8366            | 100.6341 | 104.4316 (44)  |
| Energy conte                             | 154.8691 | 135.4495 | 139.7718 | 121.8564 | 116.9241 | 100.8966 | 93.4956 | 107.2875 | 108.5689 | 126.5266           | 138.1136 | 149.9825 (45)  |
| Energy content (annual)                  |          |          |          |          |          |          |         |          |          | Total = Sum(45)m = |          | 1493.7422 (45) |
| Distribution loss (46)m = 0.15 x (45)m   | 23.2304  | 20.3174  | 20.9658  | 18.2785  | 17.5386  | 15.1345  | 14.0243 | 16.0931  | 16.2853  | 18.9790            | 20.7170  | 22.4974 (46)   |
| Water storage loss:                      |          |          |          |          |          |          |         |          |          |                    |          | 150.0000 (47)  |
| Store volume                             |          |          |          |          |          |          |         |          |          |                    |          |                |

b) If manufacturer declared loss factor is not known :

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



### CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------|
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |          |          | 0.0191 (51) |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |          |          | 0.9283 (52) |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          |          | 0.5400 (53) |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          |          | 1.4364 (55) |
| Total storage loss                                              | 44.5282  | 40.2190  | 44.5282  | 43.0918  | 44.5282  | 43.0918  | 44.5282  | 44.5282  | 43.0918  | 44.5282  | 43.0918  | 44.5282  | (56)        |
| If cylinder contains dedicated solar storage                    | 44.5282  | 40.2190  | 44.5282  | 43.0918  | 44.5282  | 43.0918  | 44.5282  | 44.5282  | 43.0918  | 44.5282  | 43.0918  | 44.5282  | (57)        |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | (59)        |
| Total heat required for water heating calculated for each month | 222.6597 | 196.6797 | 207.5624 | 187.4602 | 184.7147 | 166.5004 | 161.2862 | 175.0781 | 174.1727 | 194.3172 | 203.7174 | 217.7731 | (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 =                        |          |          |          |          |          |          |          |          |          |          |          |          | (63)        |
| Output from w/h                                                 | 222.6597 | 196.6797 | 207.5624 | 187.4602 | 184.7147 | 166.5004 | 161.2862 | 175.0781 | 174.1727 | 194.3172 | 203.7174 | 217.7731 | (64)        |
| Heat gains from water heating, kWh/month                        | 105.7265 | 94.0211  | 100.7066 | 93.0003  | 93.1097  | 86.0312  | 85.3197  | 89.9056  | 88.5822  | 96.3026  | 98.4058  | 104.1016 | (65)        |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          |          | (64)        |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| (66)m                                                                               | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | 127.8692  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.5981   | 19.1832   | 15.6008   | 11.8108   | 8.8287    | 7.4536    | 8.0539    | 10.4687   | 14.0511   | 17.8411   | 20.8232   | 22.1983   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 230.3561  | 232.7465  | 226.7228  | 213.8991  | 197.7115  | 182.4975  | 172.3335  | 169.9432  | 175.9668  | 188.7905  | 204.9781  | 220.1922  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | 35.7869   | (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)                                 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | -102.2953 | (71) |
| Water heating gains (Table 5)                                                       | 142.1054  | 139.9124  | 135.3583  | 129.1671  | 125.1475  | 119.4877  | 114.6771  | 120.8408  | 123.0308  | 129.4389  | 136.6748  | 139.9216  | (72) |
| Total internal gains                                                                | 458.4203  | 456.2028  | 442.0427  | 419.2378  | 396.0485  | 373.7995  | 359.4253  | 365.6135  | 377.4095  | 400.4313  | 426.8368  | 446.6728  | (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                      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|---------------------------------|
| East        |          |          |          | 4.0700     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       |          | 27.5316 (76)                    |
| South       |          |          |          | 1.8000     | 46.7521                        | 0.7100                            | 0.7000                             | 0.7700                       |          | 28.9843 (78)                    |
| West        |          |          |          | 7.2600     | 19.6403                        | 0.7100                            | 0.7000                             | 0.7700                       |          | 49.1104 (80)                    |
|             |          |          |          |            |                                |                                   |                                    |                              |          |                                 |
| Solar gains | 105.6263 | 197.3968 | 307.3770 | 428.4443   | 512.5358                       | 520.3051                          | 497.0664                           | 434.4828                     | 350.3314 | 229.1018 129.9199 88.0718 (83)  |
| Total gains | 564.0467 | 653.5997 | 749.4196 | 847.6821   | 908.5843                       | 894.1046                          | 856.4916                           | 800.0963                     | 727.7409 | 629.5331 556.7567 534.7446 (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                                                                         | 59.0383 | 59.2203 | 59.3997 | 60.2575 | 60.4207 | 61.1924 | 61.1924 | 61.3375 | 60.8928 | 60.4207 | 60.0914 | 59.7509 |              |
| alpha                                                                       | 4.9359  | 4.9480  | 4.9600  | 5.0172  | 5.0280  | 5.0795  | 5.0795  | 5.0892  | 5.0595  | 5.0280  | 5.0061  | 4.9834  |              |
| util living area                                                            | 0.9969  | 0.9931  | 0.9812  | 0.9399  | 0.8360  | 0.6565  | 0.4905  | 0.5431  | 0.8000  | 0.9643  | 0.9935  | 0.9976  | (86)         |
| MIT                                                                         | 19.7794 | 19.9451 | 20.2193 | 20.5667 | 20.8315 | 20.9633 | 20.9931 | 20.9887 | 20.9011 | 20.5450 | 20.1006 | 19.7557 | (87)         |
| Th 2                                                                        | 19.9390 | 19.9419 | 19.9448 | 19.9582 | 19.9607 | 19.9725 | 19.9725 | 19.9746 | 19.9679 | 19.9607 | 19.9556 | 19.9503 | (88)         |
| util rest of house                                                          | 0.9959  | 0.9908  | 0.9747  | 0.9188  | 0.7833  | 0.5661  | 0.3798  | 0.4285  | 0.7207  | 0.9476  | 0.9908  | 0.9969  | (89)         |
| MIT 2                                                                       | 18.8344 | 19.0014 | 19.2742 | 19.6181 | 19.8517 | 19.9565 | 19.9708 | 19.9716 | 19.9162 | 19.6063 | 19.1679 | 18.8199 | (90)         |
| Living area fraction                                                        | 19.0543 | 19.2210 | 19.4941 | 19.8388 | 20.0797 | 20.1908 | 20.2086 | 20.2083 | 20.1453 | 19.8247 | 19.3849 | 19.0376 | (92)         |
| MIT                                                                         | 19.0543 | 19.2210 | 19.4941 | 19.8388 | 20.0797 | 20.1908 | 20.2086 | 20.2083 | 20.1453 | 19.8247 | 19.3849 | 19.0376 | (93)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 19.0543 | 19.2210 | 19.4941 | 19.8388 | 20.0797 | 20.1908 | 20.2086 | 20.2083 | 20.1453 | 19.8247 | 19.3849 | 19.0376 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 561.0696  | 646.2460  | 727.7883  | 776.4597  | 717.7966 | 524.2311 | 347.5404 | 364.3471 | 535.5545 | 594.7970 | 550.5799  | 532.5533  | (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     | 1482.1089 | 1434.1631 | 1297.3513 | 1076.5972 | 822.5012 | 541.8363 | 349.7376 | 368.2100 | 588.7755 | 905.4447 | 1212.4221 | 1472.7029 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 685.2533  | 529.4802  | 423.7549  | 216.0991  | 77.9003  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 231.1219 | 476.5264  | 699.4713  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           |           | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           |           | (99)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

|                                                                                 |         |             |
|---------------------------------------------------------------------------------|---------|-------------|
| DER                                                                             | 15.3800 | ZC1         |
| Total Floor Area                                                                | 85.4000 |             |
| Assumed number of occupants                                                     | N       | 2.5574      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF      | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |         | 15.9841 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |         | 2.1121 ZC3  |
| Total CO2 emissions                                                             |         | 33.4762 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |         | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m <sup>2</sup> /year           |         | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |         | 0.0000 ZC7  |
| Net CO2 emissions                                                               |         | 33.4762 ZC8 |

# U-VALUE CALCULATOR REPORT

surecalc ltd

|                      |                                                                 |                |              |
|----------------------|-----------------------------------------------------------------|----------------|--------------|
| Property Reference   | sc120972                                                        | Issued on Date | 17/01/2020   |
| Assessment Reference | 001                                                             | Prop Type Ref  | New Dwelling |
| Project              | Plot 5, 15-17, Kew Gardens, Bognor Regis, West Sussex, PO21 5RD |                |              |
| Calculation Type     | New Build (As Designed)                                         |                |              |

|                                    |      |               |       |      |       |
|------------------------------------|------|---------------|-------|------|-------|
| SAP Rating                         | 87 B | DER           | 14.41 | TER  | 18.33 |
| Environmental                      | 89 B | % DER < TER   | 21.38 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.84 | DREF          | 44.93 | TREF | 53.01 |
| General Requirements Compliance    | Pass | % DREF < TREF | 15.24 |      |       |

|                  |                                               |             |           |
|------------------|-----------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Mark Rogers, Surecalc Limited, [REDACTED] | Assessor ID | A320-0001 |
| Client           | Vivid Design Studio, Vivid Design Studio      |             |           |

## Building Elements

### Roof 000002 - Pitched Roof Insulated Ceiling Vivid

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 (%) |
|-------------|------------------------------------------------------------|----------------|-----------------------------------|---------------------------------|--------------|
| Ext surface |                                                            |                |                                   | 0.0400                          |              |
| Layer 1     | Loft Space                                                 |                |                                   |                                 |              |
|             | Main construction                                          | 0              | 0.0600                            | 0.0600                          | 100.00       |
| Layer 2     | Mineral wool                                               |                |                                   |                                 |              |
|             | Main construction                                          | 250            | 0.0440                            | 5.6818                          | 100.00       |
|             | Corrections - Air Gap: Level 0, Fasteners: None or plastic |                |                                   |                                 |              |
| Layer 3     | Mineral wool quilt                                         |                |                                   |                                 |              |
|             | Main construction                                          | 150            | 0.0440                            | 3.4091                          | 91.67        |
|             | Main construction                                          | 150            | 0.1300                            | 1.1538                          | 8.33         |
|             | Corrections - Air Gap: Level 0, Fasteners: None or plastic |                |                                   |                                 |              |
| Layer 4     | Plasterboard, standard                                     |                |                                   |                                 |              |
|             | Main construction                                          | 12.5           | 0.2100                            | 0.0595                          | 100.00       |
| Int surface |                                                            |                |                                   | 0.1000                          |              |

Total resistance: Upper limit = 9.109 m<sup>2</sup> K/W Lower limit = 8.873 m<sup>2</sup> K/W Average = 8.991 m<sup>2</sup> K/W  
Total correction = 0.0030 m<sup>2</sup> K/W U-value (unrounded) = 0.11 W/m<sup>2</sup> K

Unheated space: None

Total thickness: 413 mm

U-value: 0.11 W/m<sup>2</sup> K

Kappa: n/a

# U-VALUE CALCULATOR REPORT

surecalc ltd

|                      |                                                                 |                |              |
|----------------------|-----------------------------------------------------------------|----------------|--------------|
| Property Reference   | sc120972                                                        | Issued on Date | 17/01/2020   |
| Assessment Reference | 001                                                             | Prop Type Ref  | New Dwelling |
| Project              | Plot 5, 15-17, Kew Gardens, Bognor Regis, West Sussex, PO21 5RD |                |              |
| Calculation Type     | New Build (As Designed)                                         |                |              |

|                                    |      |               |       |      |       |
|------------------------------------|------|---------------|-------|------|-------|
| SAP Rating                         | 87 B | DER           | 14.41 | TBR  | 18.33 |
| Environmental                      | 89 B | % DER < TBR   | 21.38 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.84 | DREE          | 44.93 | TREE | 53.01 |
| General Requirements Compliance    | Pass | % DPER < TREE | 15.24 |      |       |

|                  |                                               |             |           |
|------------------|-----------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Mark Rogers, Surecalc Limited, [REDACTED] | Assessor ID | A320-0001 |
| Client           | Vivid Design Studio, Vivid Design Studio      |             |           |

## Building Elements

### Wall 000001 - Vivid 100 Cavity Wall Thermabead

Wall Type: Standard Wall

| Layer       | Description                                                                                                                                          | Thickness (mm) | Conductivity (W/m <sup>2</sup> K) | Resistance (m <sup>2</sup> K/W) | Fraction (%) |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------------------------|---------------------------------|--------------|
| Ext surface |                                                                                                                                                      |                |                                   | 0.0400                          |              |
| Layer 1     | Brick, outer leaf                                                                                                                                    |                |                                   |                                 |              |
|             | Main construction                                                                                                                                    | 102            | 0.7700                            | 0.1325                          | 82.81        |
|             | Main construction                                                                                                                                    | 102            | 0.9407                            | 0.1084                          | 17.19        |
| Layer 2     | Thermabead Diamond                                                                                                                                   |                |                                   |                                 |              |
|             | Main construction                                                                                                                                    | 100            | 0.0320                            | 3.1250                          | 100.00       |
|             | Corrections - Air Gap: Level 0, Fasteners: Wall ties, Cross sectional area: 12.50 mm <sup>2</sup> , Lambda: 17.000 W/m.K, per m <sup>2</sup> : 2.500 |                |                                   |                                 |              |
| Layer 3     | Supabloc *4                                                                                                                                          |                |                                   |                                 |              |
|             | Main construction                                                                                                                                    | 100            | 0.1600                            | 0.6250                          | 94.04        |
|             | Main construction                                                                                                                                    | 100            | 0.8803                            | 0.1136                          | 5.96         |
| Layer 4     | Corrections - Air Gap: Level 1, Fasteners: None or plastic                                                                                           |                |                                   |                                 |              |
|             | airspace/plaster dabs                                                                                                                                |                |                                   |                                 |              |
|             | Main construction                                                                                                                                    | 15             | 0.1000                            | 0.1500                          | 80.00        |
| Layer 5     | Corrections - Cavity Unventilated, Emissivity: Normal                                                                                                |                |                                   |                                 |              |
|             | Plasterboard, standard                                                                                                                               |                |                                   |                                 |              |
|             | Main construction                                                                                                                                    | 12.5           | 0.2100                            | 0.0595                          | 100.00       |
| Int surface |                                                                                                                                                      |                |                                   | 0.1300                          |              |

|                   |                                              |                                        |                                               |
|-------------------|----------------------------------------------|----------------------------------------|-----------------------------------------------|
| Total resistance: | Upper limit = 4.227 m <sup>2</sup> K/W       | Lower limit = 4.129 m <sup>2</sup> K/W | Average = 4.178 m <sup>2</sup> K/W            |
|                   | Total correction = 0.0001 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: n/a

# U-VALUE CALCULATOR REPORT

surecalc ltd

|                      |                                                                 |                |              |
|----------------------|-----------------------------------------------------------------|----------------|--------------|
| Property Reference   | sc120972                                                        | Issued on Date | 17/01/2020   |
| Assessment Reference | 001                                                             | Prop Type Ref  | New Dwelling |
| Project              | Plot 5, 15-17, Kew Gardens, Bognor Regis, West Sussex, PO21 5RD |                |              |
| Calculation Type     | New Build (As Designed)                                         |                |              |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 87 B | DER         | 14.41 | TBR  | 18.33 |
| Environmental                      | 89 B | % DER<TBR   | 21.38 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.84 | DREE        | 44.93 | TREE | 53.01 |
| General Requirements Compliance    | Pass | % DPER<TPER | 15.24 |      |       |

|                  |                                          |             |           |
|------------------|------------------------------------------|-------------|-----------|
| Assessor Details | Mr. Mark Rogers, Surecalc Limited        | Assessor ID | A320-0001 |
| Client           | Vivid Design Studio, Vivid Design Studio |             |           |

## Building Elements

### Floor 000003 - Vivid GF Beam & Block

Floor Type: Suspended Floor

Area = 42.70 m<sup>2</sup>, Perimeter = 19.67 m, Wall thickness = 300.00 mm, Soil: Unknown

Depth of underfloor space below ground: 0.200 m Floor wind shielding: Average (suburban)

Floor height above ground: h = 0.000 m

U-value of walls above ground: U<sub>w</sub> = 1.500 m

Ventilation openings per perimeter length: e = 0.0015 %

Mean wind speed: v = 5.000 m/s

Resistance on solum: R<sub>g</sub> = 0.000 m<sup>2</sup>K/W

| Layer       | Description                                                | Thickness<br>(mm) | Conductivity<br>(W/m <sup>2</sup> K) | Resistance<br>(m <sup>2</sup> K/W) | Fraction<br>(%) |
|-------------|------------------------------------------------------------|-------------------|--------------------------------------|------------------------------------|-----------------|
| Ext surface |                                                            |                   |                                      | 0.1700                             |                 |
| Layer 1     | Celcon Flooring -                                          |                   |                                      |                                    |                 |
|             | Main construction                                          | 100               | 0.1500                               | 0.6667                             | 90.91           |
|             | Main construction                                          | 100               | 1.0000                               | 0.1000                             | 9.09            |
| Layer 2     | Thermafloor TF70 zero ODP                                  |                   |                                      |                                    |                 |
|             | Main construction                                          | 150               | 0.0220                               | 6.8182                             | 100.00          |
|             | Corrections - Air Gap: Level 1, Fasteners: None or plastic |                   |                                      |                                    |                 |
| Layer 3     | Screed                                                     |                   |                                      |                                    |                 |
|             | Main construction                                          | 65                | 1.1500                               | 0.0565                             | 100.00          |
| Int surface |                                                            |                   |                                      | 0.1700                             |                 |

Total resistance: Upper limit = 7.826 m<sup>2</sup> K/W Lower limit = 7.655 m<sup>2</sup> K/W Average = 7.740 m<sup>2</sup> K/W

Total correction = 0.0078 m<sup>2</sup> K/W

U-value (unrounded) = 0.11 W/m<sup>2</sup> K

Unheated space: None

Total thickness: 315 mm

U-value: 0.11 W/m<sup>2</sup> K

Kappa: n/a

# THERMAL BRIDGING

## Calculation Type: New Build (As Designed)



|                                    |                                                                 |                |              |
|------------------------------------|-----------------------------------------------------------------|----------------|--------------|
| Property Reference                 | sc120972                                                        | Issued on Date | 17/01/2020   |
| Assessment Reference               | 001                                                             | Prop Type Ref  | New Dwelling |
| Property                           | Plot 5, 15-17, Kew Gardens, Bognor Regis, West Sussex, PO21 5RD |                |              |
| SAP Rating                         | 87 B                                                            | DER            | 14.41        |
| Environmental                      | 89 B                                                            | % DER<TER      | 21.38        |
| CO <sub>2</sub> Emissions (t/year) | 0.84                                                            | DERE           | 44.93        |
| General Requirements Compliance    | Pass                                                            | % DERE<TERE    | 15.24        |
| Assessor Details                   | Mr. Mark Rogers, Surecalc Limited, [REDACTED]                   |                | Assessor ID  |
|                                    |                                                                 |                | A320-0001    |
| Client                             | Vivid Design Studio, Vivid Design Studio                        |                |              |

|               | Junction detail                                      | Source Type            | Psi (W/mK) | Length (m) | Result | Reference                |
|---------------|------------------------------------------------------|------------------------|------------|------------|--------|--------------------------|
| External wall | E2 Other lintels (including other steel lintels)     | Independently assessed | 0.050      | 10.92      | 0.55   | IG Hi Therm Lintels      |
| External wall | E3 Sill                                              | Independently assessed | 0.027      | 9.96       | 0.27   | LABC Construction Detail |
| External wall | E4 Jamb                                              | Independently assessed | 0.029      | 26.70      | 0.77   | LABC Construction Detail |
| External wall | E5 Ground floor (normal)                             | Independently assessed | 0.048      | 19.67      | 0.94   | LABC Construction Detail |
| External wall | E6 Intermediate floor within a dwelling              | Independently assessed | 0.003      | 19.67      | 0.06   | LABC Construction Detail |
| External wall | E10 Eaves (insulation at ceiling level)              | Independently assessed | 0.083      | 8.44       | 0.70   | LABC Construction Detail |
| External wall | E12 Gable (insulation at ceiling level)              | Independently assessed | 0.054      | 10.16      | 0.55   | LABC Construction Detail |
| External wall | E16 Corner (normal)                                  | Independently assessed | 0.050      | 10.30      | 0.52   | LABC Construction Detail |
| External wall | E18 Party wall between dwellings                     | Independently assessed | 0.044      | 5.15       | 0.23   | LABC Construction Detail |
| External wall | E25 Staggered party wall between dwellings           | Table K1 - Default     | 0.120      | 5.15       | 0.62   |                          |
| Party wall    | P1 Party wall - Ground floor                         | Independently assessed | 0.043      | 9.02       | 0.39   | LABC Construction Detail |
| Party wall    | P2 Party wall - Intermediate floor within a dwelling | Table K1 - Default     | 0.000      | 9.02       | 0.00   |                          |
| Party wall    | P4 Party wall - Roof (insulation at ceiling level)   | Independently assessed | 0.036      | 9.02       | 0.32   | LABC Construction Detail |

Total: 5.91 W/mK:  
Y-Value: 0.032 W/m²K: