

# Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.5.58  
Printed on 29 November 2022 at 15:07:48

## Project Information:

**Assessed By:** Liam Mason (STRO033679) **Building Type:** Semi-detached House

## Dwelling Details:

### NEW DWELLING DESIGN STAGE

Total Floor Area: 73.72m<sup>2</sup>

**Site Reference :** Bell Road, Bottisham

**Plot Reference:** Plot 32

**Address :** Plot 32

## Client Details:

**Name:**

**Address :**

**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 system: Mains gas

Fuel factor: 1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 18.78 kg/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 7.96 kg/m<sup>2</sup> **OK**

## 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 52.3 kWh/m<sup>2</sup>

Dwelling Fabric Energy Efficiency (DFEE) 47.8 kWh/m<sup>2</sup> **OK**

## 2 Fabric U-values

| Element       | Average          | Highest          |           |
|---------------|------------------|------------------|-----------|
| External wall | 0.19 (max. 0.30) | 0.19 (max. 0.70) | <b>OK</b> |
| Party wall    | 0.00 (max. 0.20) | -                | <b>OK</b> |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | <b>OK</b> |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | <b>OK</b> |
| Openings      | 1.37 (max. 2.00) | 1.40 (max. 3.30) | <b>OK</b> |

## 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: Database: (rev 508, product index 016841):  
Boiler systems with radiators or underfloor heating - mains gas  
Brand name: Vaillant  
Model: ecoTEC plus 824  
Model qualifier: VUW GB 246/5-5  
(Combi)  
Efficiency 89.1 % SEDBUK2009  
Minimum 88.0 % **OK**

Secondary heating system: None

# Regulations Compliance Report

## 5 Cylinder insulation

Hot water Storage: No cylinder

## 6 Controls

Space heating controls TTZC by plumbing and electrical services **OK**  
 Hot water controls: No cylinder thermostat

No cylinder  
 Boiler interlock: Yes **OK**

## 7 Low energy lights

Percentage of fixed lights with low-energy fittings 100.0%  
 Minimum 75.0% **OK**

## 8 Mechanical ventilation

Not applicable

## 9 Summertime temperature

Overheating risk (East Anglia): Slight **OK**

Based on:

Overshading: Average or unknown  
 Windows facing: North 0.54m<sup>2</sup>  
 Windows facing: East 1.48m<sup>2</sup>  
 Windows facing: West 1.54m<sup>2</sup>  
 Windows facing: North 0.74m<sup>2</sup>  
 Windows facing: North 0.96m<sup>2</sup>  
 Windows facing: North 0.53m<sup>2</sup>  
 Windows facing: East 1.29m<sup>2</sup>  
 Windows facing: East 3.18m<sup>2</sup>  
 Windows facing: West 1.5m<sup>2</sup>  
 Windows facing: North 0.97m<sup>2</sup>  
 Ventilation rate: 4.00  
 Blinds/curtains: Dark-coloured curtain or roller blind  
 Closed 100% of daylight hours

## 10 Key features

Roofs U-value 0.11 W/m<sup>2</sup>K  
 Party Walls U-value 0 W/m<sup>2</sup>K  
 Floors U-value 0.11 W/m<sup>2</sup>K  
 Photovoltaic array

# Predicted Energy Assessment



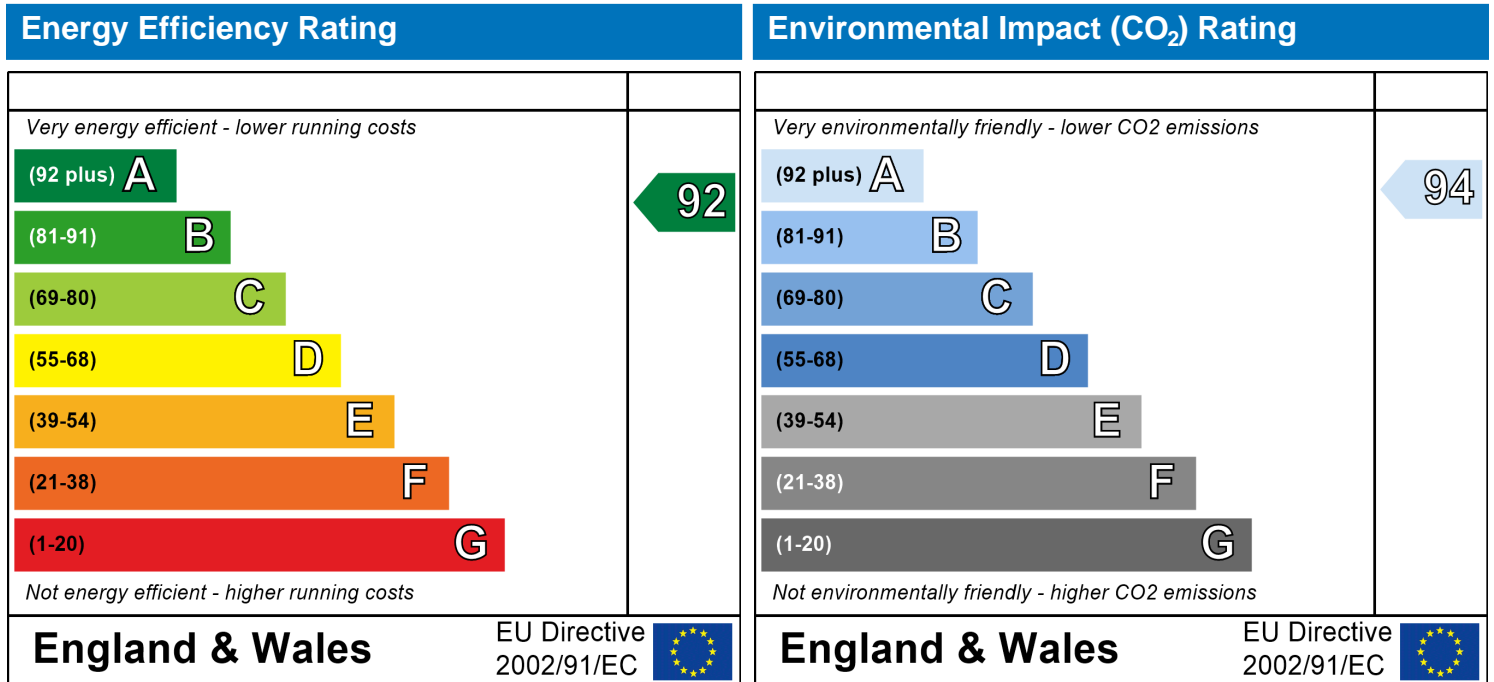
Plot 32

Dwelling type:  
Date of assessment:  
Produced by:  
Total floor area:

Semi-detached House  
03 November 2022  
Liam Mason  
73.72 m<sup>2</sup>

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact 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.

# SAP Input

## Property Details: Plot 32

Address: Plot 32  
 Located in: England  
 Region: East Anglia  
 UPRN:  
 Date of assessment: 03 November 2022  
 Date of certificate: 29 November 2022  
 Assessment type: New dwelling design stage  
 Transaction type: New dwelling  
 Tenure type: Unknown  
 Related party disclosure: No related party  
 Thermal Mass Parameter: Indicative Value Low  
 Water use <= 125 litres/person/day: True  
 PCDF Version: 508

## Property description:

Dwelling type: House  
 Detachment: Semi-detached  
 Year Completed: 2022  
 Floor Location: Floor area: Storey height:  
 Floor 0 36.86 m<sup>2</sup> 2.4 m  
 Floor 1 36.86 m<sup>2</sup> 2.4 m  
 Living area: 12.59 m<sup>2</sup> (fraction 0.171)  
 Front of dwelling faces: West

## Opening types:

| Name: | Source:      | Type:   | Glazing:                    | Argon: | Frame: |
|-------|--------------|---------|-----------------------------|--------|--------|
| D_15  | Manufacturer | Solid   |                             |        |        |
| W_127 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_128 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_129 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_130 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_131 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_132 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_133 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_134 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_135 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |
| W_136 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes    |        |

| Name: | Gap:         | Frame Factor: | g-value: | U-value: | Area: | No. of Openings: |
|-------|--------------|---------------|----------|----------|-------|------------------|
| D_15  | mm           | 0             | 0        | 1.2      | 1.95  | 1                |
| W_127 | 16mm or more | 0.7           | 0.63     | 1.4      | 0.54  | 1                |
| W_128 | 16mm or more | 0.7           | 0.63     | 1.4      | 1.48  | 1                |
| W_129 | 16mm or more | 0.7           | 0.63     | 1.4      | 1.54  | 1                |
| W_130 | 16mm or more | 0.7           | 0.63     | 1.4      | 0.74  | 1                |
| W_131 | 16mm or more | 0.7           | 0.63     | 1.4      | 0.96  | 1                |
| W_132 | 16mm or more | 0.7           | 0.63     | 1.4      | 0.53  | 1                |
| W_133 | 16mm or more | 0.7           | 0.63     | 1.4      | 1.29  | 1                |
| W_134 | 16mm or more | 0.7           | 0.63     | 1.4      | 3.18  | 1                |
| W_135 | 16mm or more | 0.7           | 0.63     | 1.4      | 1.5   | 1                |
| W_136 | 16mm or more | 0.7           | 0.63     | 1.4      | 0.97  | 1                |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|-------|------------|-----------|---------|--------|---------|
| D_15  | Doors      | Wall 1    | West    | 1.95   | 1       |
| W_127 | Windows    | Wall 1    | North   | 0.54   | 1       |
| W_128 | Windows    | Wall 1    | East    | 1.48   | 1       |

# SAP Input

|       |         |        |       |      |   |
|-------|---------|--------|-------|------|---|
| W_129 | Windows | Wall 1 | West  | 1.54 | 1 |
| W_130 | Windows | Wall 1 | North | 0.74 | 1 |
| W_131 | Windows | Wall 1 | North | 0.96 | 1 |
| W_132 | Windows | Wall 1 | North | 0.53 | 1 |
| W_133 | Windows | Wall 1 | East  | 1.29 | 1 |
| W_134 | Windows | Wall 1 | East  | 3.18 | 1 |
| W_135 | Windows | Wall 1 | West  | 1.5  | 1 |
| W_136 | Windows | Wall 1 | North | 0.97 | 1 |

Overshading: Average or unknown

## Opaque Elements:

| Type:                    | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|--------------------------|-------------|-----------|-----------|----------|-----------|---------------|--------|
| <u>External Elements</u> |             |           |           |          |           |               |        |
| Wall 1                   | 87.67       | 14.68     | 72.99     | 0.19     | 0         | False         | N/A    |
| Roof 1                   | 36.86       | 0         | 36.86     | 0.11     | 0         |               | N/A    |
| Floor 1                  | 36.86       |           |           | 0.11     |           |               | N/A    |
| <u>Internal Elements</u> |             |           |           |          |           |               |        |
| <u>Party Elements</u>    |             |           |           |          |           |               |        |
| Party Wall               | 41.77       |           |           |          |           |               | N/A    |

## Thermal bridges:

| Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0908 |        |           |     |   |  |  |  |
|--|--------|-----------|-----|---|--|--|--|
|  | Length | Psi-value |     |   |  |  |  |
|  | 11.38  | 0.3       | E2  | Other lintels (including other steel lintels) |  |  |  |
|  | 8.88   | 0.04      | E3  | Sill  |  |  |  |
|  | 27.32  | 0.05      | E4  | Jamb  |  |  |  |
|  | 17.19  | 0.16      | E5  | Ground floor (normal)                         |  |  |  |
|  | 17.19  | 0.07      | E6  | Intermediate floor within a dwelling          |  |  |  |
|  | 10.2   | 0.09      | E16 | Corner (normal)                               |  |  |  |
|  | 9      | 0.06      | E10 | Eaves (insulation at ceiling level)           |  |  |  |
|  | 10.15  | 0.24      | E12 | Gable (insulation at ceiling level)           |  |  |  |
|  | 0      | 0.3       | E2  |   |  |  |  |
|  | 0      | 0.04      | E3  |   |  |  |  |
|  | 0      | 0.05      | E4  |   |  |  |  |
|  | 0      | 0.16      | E5  |   |  |  |  |
|  | 0      | 0.07      | E6  |   |  |  |  |
|  | 0      | 0.06      | E10 |   |  |  |  |
|  | 0      | 0.24      | E12 |   |  |  |  |
|  | 0      | 0.09      | E16 |   |  |  |  |
|  | 0      | -0.09     | E17 |   |  |  |  |
|  | 0      | 0.06      | E18 |   |  |  |  |
|  | 8.19   | 0         | P2  | Intermediate floor within a dwelling          |  |  |  |
|  | 8.19   | 0.16      | P1  | Ground floor                                  |  |  |  |
|  | 0      | 0.16      | P1  |   |  |  |  |
|  | 0      | 0         | P2  |   |  |  |  |
|  | 4.5    | 0.08      | R4  | Ridge (vaulted ceiling)                       |  |  |  |
|  | 0      | 0.08      | R4  |   |  |  |  |

## Ventilation:

|                           |                                    |
|---------------------------|------------------------------------|
| Pressure test:            | Yes (As designed)                  |
| Ventilation:              | Natural ventilation (extract fans) |
| Number of chimneys:       | 0                                  |
| Number of open flues:     | 0                                  |
| Number of fans:           | 2                                  |
| Number of passive stacks: | 0                                  |

# SAP Input

Number of sides sheltered: 2  
Pressure test: 5

## Main heating system:

Main heating system: Boiler systems with radiators or underfloor heating  
Gas boilers and oil boilers  
Fuel: mains gas  
Info Source: Boiler Database  
Database: (rev 508, product index 016841) Efficiency: Winter 87.0 % Summer: 90.0  
Brand name: Vaillant  
Model: ecoTEC plus 824  
Model qualifier: VUW GB 246/5-5  
(Combi boiler)  
Systems with radiators  
Central heating pump : 2013 or later  
Design flow temperature: Design flow temperature <= 45°C  
Unknown  
Boiler interlock: Yes  
Delayed start

## Main heating Control:

Main heating Control: Time and temperature zone control by suitable arrangement of plumbing and electrical services  
Control code: 2110

## Secondary heating system:

Secondary heating system: None

## Water heating:

Water heating: From main heating system  
Water code: 901  
Fuel :mains gas  
No hot water cylinder  
Solar panel: False

## Others:

Electricity tariff: Standard Tariff  
In Smoke Control Area: Unknown  
Conservatory: No conservatory  
Low energy lights: 100%  
Terrain type: Low rise urban / suburban  
EPC language: English  
Wind turbine: No  
Photovoltaics: Photovoltaic 1  
Installed Peak power: 2  
Tilt of collector: 45°  
Overshading: None or very little  
Collector Orientation: East  
Assess Zero Carbon Home: No

## SAP WorkSheet: New dwelling design stage

### User Details:

|                       |                  |                          |                   |
|-----------------------|------------------|--------------------------|-------------------|
| <b>Assessor Name:</b> | Liam Mason       | <b>Stroma Number:</b>    | STRO033679        |
| <b>Software Name:</b> | Stroma FSAP 2012 | <b>Software Version:</b> | Version: 1.0.5.58 |

### Property Address: Plot 32

**Address :** Plot 32

### 1. Overall dwelling dimensions:

|   | Area(m <sup>2</sup> ) |        | Av. Height(m) |                                      | Volume(m <sup>3</sup> ) |
|---|-----------------------|--------|---------------|--------------------------------------|-------------------------|
| Ground floor  | 36.86                 | (1a) x | 2.4           | (2a) =                               | 88.46 (3a)              |
| First floor   | 36.86                 | (1b) x | 2.4           | (2b) =                               | 88.46 (3b)              |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 73.72                 | (4)    |               |                                      |                         |
| Dwelling volume   |                       |        |               | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | 176.93 (5)              |

### 2. Ventilation rate:

|                              | main heating |   | secondary heating |   | other |   | total |        | m <sup>3</sup> per hour |
|------------------------------|--------------|---|-------------------|---|-------|---|-------|--------|-------------------------|
| Number of chimneys           | 0            | + | 0                 | + | 0     | = | 0     | x 40 = | 0 (6a)                  |
| Number of open flues         | 0            | + | 0                 | + | 0     | = | 0     | x 20 = | 0 (6b)                  |
| Number of intermittent fans  |              |   |                   |   |       |   | 2     | x 10 = | 20 (7a)                 |
| Number of passive vents      |              |   |                   |   |       |   | 0     | x 10 = | 0 (7b)                  |
| Number of flueless gas fires |              |   |                   |   |       |   | 0     | x 40 = | 0 (7c)                  |

### Air changes per hour

|  |  |               |           |
|--|--|---------------|-----------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =  | 20                                       | ÷ (5) =       | 0.11 (8)  |
| <i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>  |  |               |           |
| Number of storeys in the dwelling (ns)   |  |               | 0 (9)     |
| Additional infiltration  |  | [(9)-1]x0.1 = | 0 (10)    |
| Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction<br><i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i> |  |               | 0 (11)    |
| If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0  |  |               | 0 (12)    |
| If no draught lobby, enter 0.05, else enter 0  |  |               | 0 (13)    |
| Percentage of windows and doors draught stripped   |  |               | 0 (14)    |
| Window infiltration  | 0.25 - [0.2 x (14) ÷ 100] =              |               | 0 (15)    |
| Infiltration rate  | (8) + (10) + (11) + (12) + (13) + (15) = |               | 0 (16)    |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area  |  |               | 5 (17)    |
| If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)   |  |               | 0.36 (18) |
| <i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>  |  |               |           |
| Number of sides sheltered  |  |               | 2 (19)    |
| Shelter factor   | (20) = 1 - [0.075 x (19)] =              |               | 0.85 (20) |
| Infiltration rate incorporating shelter factor   | (21) = (18) x (20) =                     |               | 0.31 (21) |

Infiltration rate modified for monthly wind speed

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

Monthly average wind speed from Table 7

|        |     |   |     |     |     |     |     |     |   |     |     |     |
|--------|-----|---|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|
| (22)m= | 5.1 | 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 |
|--------|-----|---|-----|-----|-----|-----|-----|-----|---|-----|-----|-----|

# SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

|         |      |      |      |     |      |      |      |      |   |      |      |      |
|---------|------|------|------|-----|------|------|------|------|---|------|------|------|
| (22a)m= | 1.27 | 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 |
|---------|------|------|------|-----|------|------|------|------|---|------|------|------|

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

|  |      |      |      |      |      |      |      |      |      |      |      |      |
|--|------|------|------|------|------|------|------|------|------|------|------|------|
|  | 0.39 | 0.39 | 0.38 | 0.34 | 0.33 | 0.29 | 0.29 | 0.29 | 0.31 | 0.33 | 0.35 | 0.36 |
|--|------|------|------|------|------|------|------|------|------|------|------|------|

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

|         |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

|         |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

|         |   |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---------|---|---|---|---|---|---|---|---|---|---|---|---|

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m<sup>2</sup> x 0.5]

|         |      |      |      |      |      |      |      |      |      |      |      |      |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|
| (24d)m= | 0.58 | 0.57 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

|        |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| (25)m= | 0.58 | 0.57 | 0.57 | 0.56 | 0.56 | 0.54 | 0.54 | 0.54 | 0.55 | 0.56 | 0.56 | 0.57 |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|

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

| ELEMENT                                | Gross area (m <sup>2</sup> ) | Openings m <sup>2</sup> | Net Area A ,m <sup>2</sup> | U-value W/m <sup>2</sup> K | A X U (W/K) | k-value kJ/m <sup>2</sup> -K | A X k kJ/K |
|--|------------------------------|-------------------------|----------------------------|----------------------------|-------------|------------------------------|------------|
| Doors                                  |                              |                         | 1.95                       | x 1.2                      | = 2.34      |                              | (26)       |
| Windows Type 1                         |                              |                         | 0.54                       | x1/[1/(1.4)+0.04]          | = 0.72      |                              | (27)       |
| Windows Type 2                         |                              |                         | 1.48                       | x1/[1/(1.4)+0.04]          | = 1.96      |                              | (27)       |
| Windows Type 3                         |                              |                         | 1.54                       | x1/[1/(1.4)+0.04]          | = 2.04      |                              | (27)       |
| Windows Type 4                         |                              |                         | 0.74                       | x1/[1/(1.4)+0.04]          | = 0.98      |                              | (27)       |
| Windows Type 5                         |                              |                         | 0.96                       | x1/[1/(1.4)+0.04]          | = 1.27      |                              | (27)       |
| Windows Type 6                         |                              |                         | 0.53                       | x1/[1/(1.4)+0.04]          | = 0.7       |                              | (27)       |
| Windows Type 7                         |                              |                         | 1.29                       | x1/[1/(1.4)+0.04]          | = 1.71      |                              | (27)       |
| Windows Type 8                         |                              |                         | 3.18                       | x1/[1/(1.4)+0.04]          | = 4.22      |                              | (27)       |
| Windows Type 9                         |                              |                         | 1.5                        | x1/[1/(1.4)+0.04]          | = 1.99      |                              | (27)       |
| Windows Type 10                        |                              |                         | 0.97                       | x1/[1/(1.4)+0.04]          | = 1.29      |                              | (27)       |
| Floor                                  |                              |                         | 36.86                      | x 0.11                     | = 4.0546    |                              | (28)       |
| Walls                                  | 87.67                        | 14.68                   | 72.99                      | x 0.19                     | = 13.87     |                              | (29)       |
| Roof                                   | 36.86                        | 0                       | 36.86                      | x 0.11                     | = 4.05      |                              | (30)       |
| Total area of elements, m <sup>2</sup> |                              |                         | 161.39                     |                            |             |                              | (31)       |
| Party wall                             |                              |                         | 41.77                      | x 0                        | = 0         |                              | (32)       |

\* for windows and roof windows, use effective window U-value calculated using formula 1/[1/U-value+0.04] as given in paragraph 3.2

\*\* include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 41.19 (33)



# SAP WorkSheet: New dwelling design stage

Heat capacity  $C_m = S(A \times k)$  ((28)...(30) + (32) + (32a)...(32e) =  (34)

Thermal mass parameter (TMP =  $C_m \div TFA$ ) in  $\text{kJ/m}^2\text{K}$  Indicative Value: Low  (35)

*For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.*

Thermal bridges :  $S (L \times Y)$  calculated using Appendix K  (36)

*if details of thermal bridging are not known (36) =  $0.05 \times (31)$*

Total fabric heat loss (33) + (36) =  (37)

Ventilation heat loss calculated monthly (38)m =  $0.33 \times (25)\text{m} \times (5)$

|        | Jan   | Feb   | Mar   | Apr   | May   | Jun  | Jul  | Aug   | Sep   | Oct   | Nov   | Dec   |      |
|--------|-------|-------|-------|-------|-------|------|------|-------|-------|-------|-------|-------|------|
| (38)m= | 33.71 | 33.54 | 33.36 | 32.56 | 32.41 | 31.7 | 31.7 | 31.57 | 31.97 | 32.41 | 32.71 | 33.03 | (38) |

Heat transfer coefficient,  $\text{W/K}$  (39)m = (37) + (38)m

|  |       |       |       |      |       |       |       |       |       |       |       |  |  |
|--|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|--|--|
| (39)m=                                     | 89.56 | 89.38 | 89.21 | 88.4 | 88.25 | 87.55 | 87.55 | 87.42 | 87.82 | 88.25 | 88.56 | 88.88                                  |  |
| Average = $\text{Sum}(39)_{1...12} / 12 =$ |       |       |       |      |       |       |       |       |       |       |       | <input type="text" value="88.4"/> (39) |  |

Heat loss parameter (HLP),  $\text{W/m}^2\text{K}$  (40)m = (39)m  $\div$  (4)

|  |      |      |      |     |     |      |      |      |      |     |     |                                       |  |
|--|------|------|------|-----|-----|------|------|------|------|-----|-----|---------------------------------------|--|
| (40)m=                                     | 1.21 | 1.21 | 1.21 | 1.2 | 1.2 | 1.19 | 1.19 | 1.19 | 1.19 | 1.2 | 1.2 | 1.21                                  |  |
| Average = $\text{Sum}(40)_{1...12} / 12 =$ |      |      |      |     |     |      |      |      |      |     |     | <input type="text" value="1.2"/> (40) |  |

Number of days in month (Table 1a)

|        | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |      |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| (41)m= | 31  | 28  | 31  | 30  | 31  | 30  | 31  | 31  | 30  | 31  | 30  | 31  | (41) |

## 4. Water heating energy requirement:

kWh/year:

Assumed occupancy,  $N$   (42)  
 if  $TFA > 13.9$ ,  $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$   
 if  $TFA \leq 13.9$ ,  $N = 1$

Annual average hot water usage in litres per day  $V_{d,average} = (25 \times N) + 36$   (43)  
*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)*

|                                     | Jan   | Feb   | Mar  | Apr   | May   | Jun   | Jul   | Aug   | Sep   | Oct  | Nov   | Dec                                       |  |
|-------------------------------------|-------|-------|------|-------|-------|-------|-------|-------|-------|------|-------|---|--|
| (44)m=                              | 98.57 | 94.98 | 91.4 | 87.82 | 84.23 | 80.65 | 80.65 | 84.23 | 87.82 | 91.4 | 94.98 | 98.57                                     |  |
| Total = $\text{Sum}(44)_{1...12} =$ |       |       |      |       |       |       |       |       |       |      |       | <input type="text" value="1075.29"/> (44) |  |

Energy content of hot water used - calculated monthly =  $4.190 \times V_{d,m} \times nm \times DTm / 3600$  kWh/month (see Tables 1b, 1c, 1d)

|                                     |        |        |        |        |        |       |       |        |        |        |        |   |  |
|-------------------------------------|--------|--------|--------|--------|--------|-------|-------|--------|--------|--------|--------|---|--|
| (45)m=                              | 146.17 | 127.84 | 131.92 | 115.01 | 110.36 | 95.23 | 88.25 | 101.26 | 102.47 | 119.42 | 130.36 | 141.56                                    |  |
| Total = $\text{Sum}(45)_{1...12} =$ |        |        |        |        |        |       |       |        |        |        |        | <input type="text" value="1409.88"/> (45) |  |

*If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)*

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (46)m= | 21.93 | 19.18 | 19.79 | 17.25 | 16.55 | 14.28 | 13.24 | 15.19 | 15.37 | 17.91 | 19.55 | 21.23 | (46) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel  (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):  (48)

Temperature factor from Table 2b  (49)

Energy lost from water storage, kWh/year (48)  $\times$  (49) =  (50)

b) If manufacturer's declared cylinder loss factor is not known:

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Hot water storage loss factor from Table 2 (kWh/litre/day) 

|   |
|---|
| 0 |
|---|

 (51)

If community heating see section 4.3

Volume factor from Table 2a 

|   |
|---|
| 0 |
|---|

 (52)

Temperature factor from Table 2b 

|   |
|---|
| 0 |
|---|

 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 

|   |
|---|
| 0 |
|---|

 (54)

Enter (50) or (54) in (55) 

|   |
|---|
| 0 |
|---|

 (55)

Water storage loss calculated for each month ((56)m = (55) x (41)m

(56)m= 

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

 (56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m= 

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

 (57)

Primary circuit loss (annual) from Table 3 

|   |
|---|
| 0 |
|---|

 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m= 

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

 (59)

Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m

(61)m= 

|       |      |       |       |       |      |       |       |       |       |       |       |
|-------|------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|
| 25.82 | 23.3 | 25.75 | 24.88 | 25.67 | 24.8 | 25.61 | 25.65 | 24.84 | 25.72 | 24.94 | 25.81 |
|-------|------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|

 (61)

Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m

(62)m= 

|     |        |        |        |        |        |        |        |        |        |       |        |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| 172 | 151.14 | 157.68 | 139.89 | 136.03 | 120.04 | 113.85 | 126.91 | 127.32 | 145.14 | 155.3 | 167.37 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|

 (62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m= 

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

 (63)

Output from water heater

(64)m= 

|     |        |        |        |        |        |        |        |        |        |       |        |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| 172 | 151.14 | 157.68 | 139.89 | 136.03 | 120.04 | 113.85 | 126.91 | 127.32 | 145.14 | 155.3 | 167.37 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|

Output from water heater (annual)<sub>1...12</sub>

|         |
|---------|
| 1712.68 |
|---------|

 (64)

Heat gains from water heating, kWh/month  $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m= 

|       |       |      |       |       |       |       |       |       |       |       |       |
|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 55.06 | 48.33 | 50.3 | 44.46 | 43.11 | 37.87 | 35.74 | 40.08 | 40.28 | 46.14 | 49.58 | 53.52 |
|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

(66)m= 

|        | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 | 139.98 |

 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m= 

|       |      |       |      |       |       |       |       |       |       |       |       |
|-------|------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 47.18 | 41.9 | 34.08 | 25.8 | 19.29 | 16.28 | 17.59 | 22.87 | 30.69 | 38.97 | 45.49 | 48.49 |
|-------|------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|

 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 307.19 | 310.38 | 302.35 | 285.25 | 263.66 | 243.37 | 229.82 | 226.63 | 234.66 | 251.76 | 273.35 | 293.64 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m= 

|       |       |       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 51.33 | 51.33 | 51.33 | 51.33 | 51.33 | 51.33 | 51.33 | 51.33 | 51.33 | 51.33 | 51.33 | 51.33 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (69)

Pumps and fans gains (Table 5a)

(70)m= 

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|

 (70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m= 

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| -93.32 | -93.32 | -93.32 | -93.32 | -93.32 | -93.32 | -93.32 | -93.32 | -93.32 | -93.32 | -93.32 | -93.32 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

 (71)

Water heating gains (Table 5)

(72)m= 

|    |       |       |       |       |       |       |       |       |       |       |       |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 74 | 71.92 | 67.61 | 61.75 | 57.95 | 52.59 | 48.04 | 53.87 | 55.95 | 62.01 | 68.86 | 71.94 |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|

 (72)

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**Total internal gains =**

$$(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$$

|        |        |       |        |        |        |        |        |        |        |        |        |        |
|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (73)m= | 529.37 | 525.2 | 505.03 | 473.79 | 441.88 | 413.23 | 396.44 | 404.36 | 422.29 | 453.74 | 488.69 | 515.06 |
|--------|--------|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

(73)

**6. Solar gains:**

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

| Orientation: | Access Factor<br>Table 6d | Area<br>m <sup>2</sup> | Flux<br>Table 6a | g <sub>-</sub><br>Table 6b | FF<br>Table 6c | Gains<br>(W) |   |      |   |     |   |       |      |
|--------------|---------------------------|------------------------|------------------|----------------------------|----------------|--------------|---|------|---|-----|---|-------|------|
| North        | 0.9x                      | 0.77                   | x                | 0.54                       | x              | 10.63        | x | 0.63 | x | 0.7 | = | 1.75  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.74                       | x              | 10.63        | x | 0.63 | x | 0.7 | = | 2.4   | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.96                       | x              | 10.63        | x | 0.63 | x | 0.7 | = | 3.12  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.53                       | x              | 10.63        | x | 0.63 | x | 0.7 | = | 1.72  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.97                       | x              | 10.63        | x | 0.63 | x | 0.7 | = | 3.15  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.54                       | x              | 20.32        | x | 0.63 | x | 0.7 | = | 3.35  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.74                       | x              | 20.32        | x | 0.63 | x | 0.7 | = | 4.6   | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.96                       | x              | 20.32        | x | 0.63 | x | 0.7 | = | 5.96  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.53                       | x              | 20.32        | x | 0.63 | x | 0.7 | = | 3.29  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.97                       | x              | 20.32        | x | 0.63 | x | 0.7 | = | 6.02  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.54                       | x              | 34.53        | x | 0.63 | x | 0.7 | = | 5.7   | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.74                       | x              | 34.53        | x | 0.63 | x | 0.7 | = | 7.81  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.96                       | x              | 34.53        | x | 0.63 | x | 0.7 | = | 10.13 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.53                       | x              | 34.53        | x | 0.63 | x | 0.7 | = | 5.59  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.97                       | x              | 34.53        | x | 0.63 | x | 0.7 | = | 10.24 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.54                       | x              | 55.46        | x | 0.63 | x | 0.7 | = | 9.15  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.74                       | x              | 55.46        | x | 0.63 | x | 0.7 | = | 12.54 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.96                       | x              | 55.46        | x | 0.63 | x | 0.7 | = | 16.27 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.53                       | x              | 55.46        | x | 0.63 | x | 0.7 | = | 8.98  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.97                       | x              | 55.46        | x | 0.63 | x | 0.7 | = | 16.44 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.54                       | x              | 74.72        | x | 0.63 | x | 0.7 | = | 12.33 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.74                       | x              | 74.72        | x | 0.63 | x | 0.7 | = | 16.9  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.96                       | x              | 74.72        | x | 0.63 | x | 0.7 | = | 21.92 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.53                       | x              | 74.72        | x | 0.63 | x | 0.7 | = | 12.1  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.97                       | x              | 74.72        | x | 0.63 | x | 0.7 | = | 22.15 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.54                       | x              | 79.99        | x | 0.63 | x | 0.7 | = | 13.2  | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.74                       | x              | 79.99        | x | 0.63 | x | 0.7 | = | 18.09 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.96                       | x              | 79.99        | x | 0.63 | x | 0.7 | = | 23.47 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.53                       | x              | 79.99        | x | 0.63 | x | 0.7 | = | 12.96 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.97                       | x              | 79.99        | x | 0.63 | x | 0.7 | = | 23.71 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.54                       | x              | 74.68        | x | 0.63 | x | 0.7 | = | 12.32 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.74                       | x              | 74.68        | x | 0.63 | x | 0.7 | = | 16.89 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.96                       | x              | 74.68        | x | 0.63 | x | 0.7 | = | 21.91 | (74) |
| North        | 0.9x                      | 0.77                   | x                | 0.53                       | x              | 74.68        | x | 0.63 | x | 0.7 | = | 12.1  | (74) |

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|       |      |      |   |      |   |        |   |      |   |     |   |        |      |
|-------|------|------|---|------|---|--------|---|------|---|-----|---|--------|------|
| North | 0.9x | 0.77 | x | 0.97 | x | 74.68  | x | 0.63 | x | 0.7 | = | 22.14  | (74) |
| North | 0.9x | 0.77 | x | 0.54 | x | 59.25  | x | 0.63 | x | 0.7 | = | 9.78   | (74) |
| North | 0.9x | 0.77 | x | 0.74 | x | 59.25  | x | 0.63 | x | 0.7 | = | 13.4   | (74) |
| North | 0.9x | 0.77 | x | 0.96 | x | 59.25  | x | 0.63 | x | 0.7 | = | 17.38  | (74) |
| North | 0.9x | 0.77 | x | 0.53 | x | 59.25  | x | 0.63 | x | 0.7 | = | 9.6    | (74) |
| North | 0.9x | 0.77 | x | 0.97 | x | 59.25  | x | 0.63 | x | 0.7 | = | 17.56  | (74) |
| North | 0.9x | 0.77 | x | 0.54 | x | 41.52  | x | 0.63 | x | 0.7 | = | 6.85   | (74) |
| North | 0.9x | 0.77 | x | 0.74 | x | 41.52  | x | 0.63 | x | 0.7 | = | 9.39   | (74) |
| North | 0.9x | 0.77 | x | 0.96 | x | 41.52  | x | 0.63 | x | 0.7 | = | 12.18  | (74) |
| North | 0.9x | 0.77 | x | 0.53 | x | 41.52  | x | 0.63 | x | 0.7 | = | 6.72   | (74) |
| North | 0.9x | 0.77 | x | 0.97 | x | 41.52  | x | 0.63 | x | 0.7 | = | 12.31  | (74) |
| North | 0.9x | 0.77 | x | 0.54 | x | 24.19  | x | 0.63 | x | 0.7 | = | 3.99   | (74) |
| North | 0.9x | 0.77 | x | 0.74 | x | 24.19  | x | 0.63 | x | 0.7 | = | 5.47   | (74) |
| North | 0.9x | 0.77 | x | 0.96 | x | 24.19  | x | 0.63 | x | 0.7 | = | 7.1    | (74) |
| North | 0.9x | 0.77 | x | 0.53 | x | 24.19  | x | 0.63 | x | 0.7 | = | 3.92   | (74) |
| North | 0.9x | 0.77 | x | 0.97 | x | 24.19  | x | 0.63 | x | 0.7 | = | 7.17   | (74) |
| North | 0.9x | 0.77 | x | 0.54 | x | 13.12  | x | 0.63 | x | 0.7 | = | 2.16   | (74) |
| North | 0.9x | 0.77 | x | 0.74 | x | 13.12  | x | 0.63 | x | 0.7 | = | 2.97   | (74) |
| North | 0.9x | 0.77 | x | 0.96 | x | 13.12  | x | 0.63 | x | 0.7 | = | 3.85   | (74) |
| North | 0.9x | 0.77 | x | 0.53 | x | 13.12  | x | 0.63 | x | 0.7 | = | 2.12   | (74) |
| North | 0.9x | 0.77 | x | 0.97 | x | 13.12  | x | 0.63 | x | 0.7 | = | 3.89   | (74) |
| North | 0.9x | 0.77 | x | 0.54 | x | 8.86   | x | 0.63 | x | 0.7 | = | 1.46   | (74) |
| North | 0.9x | 0.77 | x | 0.74 | x | 8.86   | x | 0.63 | x | 0.7 | = | 2      | (74) |
| North | 0.9x | 0.77 | x | 0.96 | x | 8.86   | x | 0.63 | x | 0.7 | = | 2.6    | (74) |
| North | 0.9x | 0.77 | x | 0.53 | x | 8.86   | x | 0.63 | x | 0.7 | = | 1.44   | (74) |
| North | 0.9x | 0.77 | x | 0.97 | x | 8.86   | x | 0.63 | x | 0.7 | = | 2.63   | (74) |
| East  | 0.9x | 0.77 | x | 1.48 | x | 19.64  | x | 0.63 | x | 0.7 | = | 8.88   | (76) |
| East  | 0.9x | 0.77 | x | 1.29 | x | 19.64  | x | 0.63 | x | 0.7 | = | 7.74   | (76) |
| East  | 0.9x | 0.77 | x | 3.18 | x | 19.64  | x | 0.63 | x | 0.7 | = | 19.09  | (76) |
| East  | 0.9x | 0.77 | x | 1.48 | x | 38.42  | x | 0.63 | x | 0.7 | = | 17.38  | (76) |
| East  | 0.9x | 0.77 | x | 1.29 | x | 38.42  | x | 0.63 | x | 0.7 | = | 15.15  | (76) |
| East  | 0.9x | 0.77 | x | 3.18 | x | 38.42  | x | 0.63 | x | 0.7 | = | 37.34  | (76) |
| East  | 0.9x | 0.77 | x | 1.48 | x | 63.27  | x | 0.63 | x | 0.7 | = | 28.62  | (76) |
| East  | 0.9x | 0.77 | x | 1.29 | x | 63.27  | x | 0.63 | x | 0.7 | = | 24.94  | (76) |
| East  | 0.9x | 0.77 | x | 3.18 | x | 63.27  | x | 0.63 | x | 0.7 | = | 61.49  | (76) |
| East  | 0.9x | 0.77 | x | 1.48 | x | 92.28  | x | 0.63 | x | 0.7 | = | 41.74  | (76) |
| East  | 0.9x | 0.77 | x | 1.29 | x | 92.28  | x | 0.63 | x | 0.7 | = | 36.38  | (76) |
| East  | 0.9x | 0.77 | x | 3.18 | x | 92.28  | x | 0.63 | x | 0.7 | = | 89.68  | (76) |
| East  | 0.9x | 0.77 | x | 1.48 | x | 113.09 | x | 0.63 | x | 0.7 | = | 51.15  | (76) |
| East  | 0.9x | 0.77 | x | 1.29 | x | 113.09 | x | 0.63 | x | 0.7 | = | 44.59  | (76) |
| East  | 0.9x | 0.77 | x | 3.18 | x | 113.09 | x | 0.63 | x | 0.7 | = | 109.91 | (76) |

## SAP WorkSheet: New dwelling design stage

|      |      |      |   |      |   |        |   |      |   |     |   |        |      |
|------|------|------|---|------|---|--------|---|------|---|-----|---|--------|------|
| East | 0.9x | 0.77 | x | 1.48 | x | 115.77 | x | 0.63 | x | 0.7 | = | 52.36  | (76) |
| East | 0.9x | 0.77 | x | 1.29 | x | 115.77 | x | 0.63 | x | 0.7 | = | 45.64  | (76) |
| East | 0.9x | 0.77 | x | 3.18 | x | 115.77 | x | 0.63 | x | 0.7 | = | 112.51 | (76) |
| East | 0.9x | 0.77 | x | 1.48 | x | 110.22 | x | 0.63 | x | 0.7 | = | 49.85  | (76) |
| East | 0.9x | 0.77 | x | 1.29 | x | 110.22 | x | 0.63 | x | 0.7 | = | 43.45  | (76) |
| East | 0.9x | 0.77 | x | 3.18 | x | 110.22 | x | 0.63 | x | 0.7 | = | 107.12 | (76) |
| East | 0.9x | 0.77 | x | 1.48 | x | 94.68  | x | 0.63 | x | 0.7 | = | 42.82  | (76) |
| East | 0.9x | 0.77 | x | 1.29 | x | 94.68  | x | 0.63 | x | 0.7 | = | 37.33  | (76) |
| East | 0.9x | 0.77 | x | 3.18 | x | 94.68  | x | 0.63 | x | 0.7 | = | 92.01  | (76) |
| East | 0.9x | 0.77 | x | 1.48 | x | 73.59  | x | 0.63 | x | 0.7 | = | 33.28  | (76) |
| East | 0.9x | 0.77 | x | 1.29 | x | 73.59  | x | 0.63 | x | 0.7 | = | 29.01  | (76) |
| East | 0.9x | 0.77 | x | 3.18 | x | 73.59  | x | 0.63 | x | 0.7 | = | 71.52  | (76) |
| East | 0.9x | 0.77 | x | 1.48 | x | 45.59  | x | 0.63 | x | 0.7 | = | 20.62  | (76) |
| East | 0.9x | 0.77 | x | 1.29 | x | 45.59  | x | 0.63 | x | 0.7 | = | 17.97  | (76) |
| East | 0.9x | 0.77 | x | 3.18 | x | 45.59  | x | 0.63 | x | 0.7 | = | 44.31  | (76) |
| East | 0.9x | 0.77 | x | 1.48 | x | 24.49  | x | 0.63 | x | 0.7 | = | 11.08  | (76) |
| East | 0.9x | 0.77 | x | 1.29 | x | 24.49  | x | 0.63 | x | 0.7 | = | 9.65   | (76) |
| East | 0.9x | 0.77 | x | 3.18 | x | 24.49  | x | 0.63 | x | 0.7 | = | 23.8   | (76) |
| East | 0.9x | 0.77 | x | 1.48 | x | 16.15  | x | 0.63 | x | 0.7 | = | 7.31   | (76) |
| East | 0.9x | 0.77 | x | 1.29 | x | 16.15  | x | 0.63 | x | 0.7 | = | 6.37   | (76) |
| East | 0.9x | 0.77 | x | 3.18 | x | 16.15  | x | 0.63 | x | 0.7 | = | 15.7   | (76) |
| West | 0.9x | 0.77 | x | 1.54 | x | 19.64  | x | 0.63 | x | 0.7 | = | 9.24   | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 19.64  | x | 0.63 | x | 0.7 | = | 9      | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 38.42  | x | 0.63 | x | 0.7 | = | 18.08  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 38.42  | x | 0.63 | x | 0.7 | = | 17.61  | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 63.27  | x | 0.63 | x | 0.7 | = | 29.78  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 63.27  | x | 0.63 | x | 0.7 | = | 29.01  | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 92.28  | x | 0.63 | x | 0.7 | = | 43.43  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 92.28  | x | 0.63 | x | 0.7 | = | 42.3   | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 113.09 | x | 0.63 | x | 0.7 | = | 53.23  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 113.09 | x | 0.63 | x | 0.7 | = | 51.84  | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 115.77 | x | 0.63 | x | 0.7 | = | 54.49  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 115.77 | x | 0.63 | x | 0.7 | = | 53.07  | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 110.22 | x | 0.63 | x | 0.7 | = | 51.87  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 110.22 | x | 0.63 | x | 0.7 | = | 50.53  | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 94.68  | x | 0.63 | x | 0.7 | = | 44.56  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 94.68  | x | 0.63 | x | 0.7 | = | 43.4   | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 73.59  | x | 0.63 | x | 0.7 | = | 34.63  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 73.59  | x | 0.63 | x | 0.7 | = | 33.73  | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 45.59  | x | 0.63 | x | 0.7 | = | 21.46  | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 45.59  | x | 0.63 | x | 0.7 | = | 20.9   | (80) |

## SAP WorkSheet: New dwelling design stage

|      |      |      |   |      |   |       |   |      |   |     |   |       |      |
|------|------|------|---|------|---|-------|---|------|---|-----|---|-------|------|
| West | 0.9x | 0.77 | x | 1.54 | x | 24.49 | x | 0.63 | x | 0.7 | = | 11.53 | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 24.49 | x | 0.63 | x | 0.7 | = | 11.23 | (80) |
| West | 0.9x | 0.77 | x | 1.54 | x | 16.15 | x | 0.63 | x | 0.7 | = | 7.6   | (80) |
| West | 0.9x | 0.77 | x | 1.5  | x | 16.15 | x | 0.63 | x | 0.7 | = | 7.4   | (80) |

Solar gains in watts, calculated for each month

$$(83)m = \text{Sum}(74)m \dots (82)m$$

|        |       |        |        |        |        |       |        |        |        |       |       |       |      |
|--------|-------|--------|--------|--------|--------|-------|--------|--------|--------|-------|-------|-------|------|
| (83)m= | 66.11 | 128.79 | 213.31 | 316.93 | 396.12 | 409.5 | 388.18 | 327.84 | 249.64 | 152.9 | 82.28 | 54.51 | (83) |
|--------|-------|--------|--------|--------|--------|-------|--------|--------|--------|-------|-------|-------|------|

Total gains – internal and solar (84)m = (73)m + (83)m , watts

|        |        |        |        |        |     |        |        |       |        |        |        |        |      |
|--------|--------|--------|--------|--------|-----|--------|--------|-------|--------|--------|--------|--------|------|
| (84)m= | 595.48 | 653.98 | 718.34 | 790.72 | 838 | 822.73 | 784.62 | 732.2 | 671.93 | 606.64 | 570.96 | 569.56 | (84) |
|--------|--------|--------|--------|--------|-----|--------|--------|-------|--------|--------|--------|--------|------|

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

Temperature during heating periods in the living area from Table 9, Th1 (°C)

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

|        | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |      |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| (86)m= | 0.94 | 0.92 | 0.89 | 0.82 | 0.71 | 0.57 | 0.45 | 0.49 | 0.68 | 0.85 | 0.92 | 0.94 | (86) |

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (87)m= | 18.78 | 19.01 | 19.44 | 19.99 | 20.46 | 20.79 | 20.92 | 20.89 | 20.64 | 20.04 | 19.32 | 18.73 | (87) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (88)m= | 19.91 | 19.91 | 19.91 | 19.92 | 19.92 | 19.93 | 19.93 | 19.93 | 19.93 | 19.92 | 19.92 | 19.92 | (88) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

|        |      |      |      |      |      |     |      |      |      |      |      |      |      |
|--------|------|------|------|------|------|-----|------|------|------|------|------|------|------|
| (89)m= | 0.93 | 0.91 | 0.87 | 0.79 | 0.66 | 0.5 | 0.35 | 0.39 | 0.62 | 0.82 | 0.91 | 0.94 | (89) |
|--------|------|------|------|------|------|-----|------|------|------|------|------|------|------|

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

|        |       |       |       |      |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (90)m= | 16.98 | 17.32 | 17.92 | 18.7 | 19.33 | 19.74 | 19.88 | 19.86 | 19.58 | 18.78 | 17.76 | 16.91 | (90) |
|--------|-------|-------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|------|

$$fLA = \text{Living area} \div (4) =$$

0.17 (91)

Mean internal temperature (for the whole dwelling) = fLA x T1 + (1 – fLA) x T2

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (92)m= | 17.29 | 17.61 | 18.18 | 18.92 | 19.53 | 19.92 | 20.06 | 20.04 | 19.76 | 18.99 | 18.03 | 17.22 | (92) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

|        |       |       |       |       |       |       |       |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| (93)m= | 17.14 | 17.46 | 18.03 | 18.77 | 19.38 | 19.77 | 19.91 | 19.89 | 19.61 | 18.84 | 17.88 | 17.07 | (93) |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|

### 8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

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

Utilisation factor for gains, hm:

|        |     |      |      |      |      |      |      |      |      |      |      |      |      |
|--------|-----|------|------|------|------|------|------|------|------|------|------|------|------|
| (94)m= | 0.9 | 0.87 | 0.83 | 0.75 | 0.64 | 0.49 | 0.35 | 0.39 | 0.59 | 0.78 | 0.87 | 0.91 | (94) |
|--------|-----|------|------|------|------|------|------|------|------|------|------|------|------|

Useful gains, hmGm , W = (94)m x (84)m

|        |        |        |        |       |       |        |        |        |        |       |        |        |      |
|--------|--------|--------|--------|-------|-------|--------|--------|--------|--------|-------|--------|--------|------|
| (95)m= | 534.97 | 572.09 | 596.74 | 594.7 | 534.9 | 402.39 | 274.72 | 285.05 | 399.12 | 473.1 | 496.79 | 516.24 | (95) |
|--------|--------|--------|--------|-------|-------|--------|--------|--------|--------|-------|--------|--------|------|

Monthly average external temperature from Table 8

|        |     |     |     |     |      |      |      |      |      |      |     |     |      |
|--------|-----|-----|-----|-----|------|------|------|------|------|------|-----|-----|------|
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | (96) |
|--------|-----|-----|-----|-----|------|------|------|------|------|------|-----|-----|------|

Heat loss rate for mean internal temperature, Lm , W = [(39)m x [(93)m – (96)m ]

|        |         |         |        |        |        |        |        |        |        |       |        |         |      |
|--------|---------|---------|--------|--------|--------|--------|--------|--------|--------|-------|--------|---------|------|
| (97)m= | 1149.56 | 1122.25 | 1028.6 | 872.22 | 677.45 | 452.41 | 289.36 | 304.76 | 484.32 | 727.6 | 954.45 | 1143.83 | (97) |
|--------|---------|---------|--------|--------|--------|--------|--------|--------|--------|-------|--------|---------|------|

Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m

|        |        |        |       |        |        |   |   |   |   |        |        |        |      |
|--------|--------|--------|-------|--------|--------|---|---|---|---|--------|--------|--------|------|
| (98)m= | 457.25 | 369.71 | 321.3 | 199.81 | 106.06 | 0 | 0 | 0 | 0 | 189.35 | 329.52 | 466.93 | (98) |
|--------|--------|--------|-------|--------|--------|---|---|---|---|--------|--------|--------|------|

$$\text{Total per year (kWh/year)} = \text{Sum}(98)_{1, \dots, 5, 9, \dots, 12} =$$

2439.92 (98)

Space heating requirement in kWh/m<sup>2</sup>/year

33.1 (99)

# SAP WorkSheet: New dwelling design stage

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

### Space heating:

|  |                               |      |       |
|--|-------------------------------|------|-------|
| Fraction of space heat from secondary/supplementary system |                               | 0    | (201) |
| Fraction of space heat from main system(s)                 | (202) = 1 – (201) =           | 1    | (202) |
| Fraction of total heating from main system 1               | (204) = (202) × [1 – (203)] = | 1    | (204) |
| Efficiency of main space heating system 1                  |                               | 92.4 | (206) |
| Efficiency of secondary/supplementary heating system, %    |                               | 0    | (208) |

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

Space heating requirement (calculated above)

|        |        |       |        |        |   |   |   |   |        |        |        |
|--------|--------|-------|--------|--------|---|---|---|---|--------|--------|--------|
| 457.25 | 369.71 | 321.3 | 199.81 | 106.06 | 0 | 0 | 0 | 0 | 189.35 | 329.52 | 466.93 |
|--------|--------|-------|--------|--------|---|---|---|---|--------|--------|--------|

(211)m = {[ (98)m x (204)] } x 100 ÷ (206) (211)

|        |        |        |        |        |   |   |   |   |        |        |        |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|
| 494.86 | 400.12 | 347.73 | 216.24 | 114.78 | 0 | 0 | 0 | 0 | 204.93 | 356.62 | 505.33 |
|--------|--------|--------|--------|--------|---|---|---|---|--------|--------|--------|

Total (kWh/year) = Sum(211)<sub>1...5,10...12</sub> = 2640.61 (211)

Space heating fuel (secondary), kWh/month

= {[ (98)m x (201)] } x 100 ÷ (208)

(215)m =

|   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Total (kWh/year) = Sum(215)<sub>1...5,10...12</sub> = 0 (215)

### Water heating

Output from water heater (calculated above)

|     |        |        |        |        |        |        |        |        |        |       |        |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|
| 172 | 151.14 | 157.68 | 139.89 | 136.03 | 120.04 | 113.85 | 126.91 | 127.32 | 145.14 | 155.3 | 167.37 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|--------|

Efficiency of water heater 87 (216)

(217)m = 89.16 89.11 88.99 88.74 88.29 87 87 87 87 88.67 89.02 89.19 (217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m =

|        |        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 192.91 | 169.62 | 177.19 | 157.64 | 154.07 | 137.97 | 130.86 | 145.88 | 146.34 | 163.68 | 174.47 | 187.66 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

Total = Sum(219a)<sub>1...12</sub> = 1938.29 (219)

### Annual totals

|  |                 |                 |
|--|-----------------|-----------------|
|  | <b>kWh/year</b> | <b>kWh/year</b> |
| Space heating fuel used, main system 1 |                 | 2640.61         |
| Water heating fuel used                |                 | 1938.29         |

Electricity for pumps, fans and electric keep-hot

central heating pump: 30 (230c)

boiler with a fan-assisted flue 45 (230e)

Total electricity for the above, kWh/year sum of (230a)...(230g) = 75 (231)

Electricity for lighting 333.28 (232)

Electricity generated by PVs -1364.85 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 3622.34 (338)

## 10a. Fuel costs - individual heating systems:

|                               | Fuel<br>kWh/year | Fuel Price<br>(Table 12) | Fuel Cost<br>£/year  |
|-------------------------------|------------------|--------------------------|----------------------|
| Space heating - main system 1 | (211) x          | 3.48                     | x 0.01 = 91.89 (240) |
| Space heating - main system 2 | (213) x          | 0                        | x 0.01 = 0 (241)     |



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|  |                                 |       |          |         |       |
|--|---------------------------------|-------|----------|---------|-------|
| Space heating - secondary  | (215) x                         | 13.19 | x 0.01 = | 0       | (242) |
| Water heating cost (other fuel)  | (219)                           | 3.48  | x 0.01 = | 67.45   | (247) |
| Pumps, fans and electric keep-hot  | (231)                           | 13.19 | x 0.01 = | 9.89    | (249) |
| <small>(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a</small> |                                 |       |          |         |       |
| Energy for lighting  | (232)                           | 13.19 | x 0.01 = | 43.96   | (250) |
| Additional standing charges (Table 12)   |                                 |       |          | 120     | (251) |
|  | one of (233) to (235) x         | 13.19 | x 0.01 = | -180.02 | (252) |
| Appendix Q items: repeat lines (253) and (254) as needed   |                                 |       |          |         |       |
| <b>Total energy cost</b>   | (245)...(247) + (250)...(254) = |       |          | 153.17  | (255) |

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

|                                 |                                  |  |  |       |       |
|---------------------------------|----------------------------------|--|--|-------|-------|
| Energy cost deflator (Table 12) |                                  |  |  | 0.42  | (256) |
| Energy cost factor (ECF)        | [(255) x (256)] ÷ [(4) + 45.0] = |  |  | 0.54  | (257) |
| <b>SAP rating (Section 12)</b>  |                                  |  |  | 92.44 | (258) |

### 12a. CO2 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)                     | (211) x                         |  | 0.216                         | =                      | 570.37 (261)             |
| Space heating (secondary)                         | (215) x                         |  | 0.519                         | =                      | 0 (263)                  |
| Water heating                                     | (219) x                         |  | 0.216                         | =                      | 418.67 (264)             |
| Space and water heating                           | (261) + (262) + (263) + (264) = |  |                               |                        | 989.04 (265)             |
| Electricity for pumps, fans and electric keep-hot | (231) x                         |  | 0.519                         | =                      | 38.93 (267)              |
| Electricity for lighting                          | (232) x                         |  | 0.519                         | =                      | 172.97 (268)             |
| Energy saving/generation technologies<br>Item 1   |                                 |  | 0.519                         | =                      | -708.36 (269)            |
| Total CO2, kg/year                                |                                 |  |                               | sum of (265)...(271) = | 492.59 (272)             |
| <b>CO2 emissions per m²</b>                       |                                 |  |                               | (272) ÷ (4) =          | 6.68 (273)               |
| El rating (section 14)                            |                                 |  |                               |                        | 94 (274)                 |

### 13a. Primary Energy

|   | Energy<br>kWh/year              |  | Primary<br>factor |   | P. Energy<br>kWh/year |
|---|---------------------------------|--|-------------------|---|-----------------------|
| Space heating (main system 1)                     | (211) x                         |  | 1.22              | = | 3221.55 (261)         |
| Space heating (secondary)                         | (215) x                         |  | 3.07              | = | 0 (263)               |
| Energy for water heating                          | (219) x                         |  | 1.22              | = | 2364.72 (264)         |
| Space and water heating                           | (261) + (262) + (263) + (264) = |  |                   |   | 5586.27 (265)         |
| Electricity for pumps, fans and electric keep-hot | (231) x                         |  | 3.07              | = | 230.25 (267)          |
| Electricity for lighting                          | (232) x                         |  | 0                 | = | 1023.18 (268)         |



# SAP WorkSheet: New dwelling design stage

Energy saving/generation technologies

Item 1

3.07

=

-4190.08 (269)

'Total Primary Energy

sum of (265)...(271) =

2649.61 (272)

**Primary energy kWh/m<sup>2</sup>/year**

(272) ÷ (4) =

35.94 (273)

# SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 29 November 2022

## Property Details: Plot 32

|   |                                       |
|---|---------------------------------------|
| <b>Dwelling type:</b>                             | Semi-detached House                   |
| <b>Located in:</b>                                | England                               |
| <b>Region:</b>                                    | East Anglia                           |
| <b>Cross ventilation possible:</b>                | Yes                                   |
| <b>Number of storeys:</b>                         | 2                                     |
| <b>Front of dwelling faces:</b>                   | West                                  |
| <b>Overshading:</b>                               | Average or unknown                    |
| <b>Overhangs:</b>                                 | None                                  |
| <b>Thermal mass parameter:</b>                    | Indicative Value Low                  |
| <b>Night ventilation:</b>                         | False                                 |
| <b>Blinds, curtains, shutters:</b>                | Dark-coloured curtain or roller blind |
| <b>Ventilation rate during hot weather (ach):</b> | 4 ( Windows open half the time)       |

## Overheating Details:

|  |        |             |
|--|--------|-------------|
| <b>Summer ventilation heat loss coefficient:</b> | 233.54 | <b>(P1)</b> |
| <b>Transmission heat loss coefficient:</b>       | 55.8   |             |
| <b>Summer heat loss coefficient:</b>             | 289.39 | <b>(P2)</b> |

## Overhangs:

| <b>Orientation:</b> | <b>Ratio:</b> | <b>Z_overhangs:</b> |
|---------------------|---------------|---------------------|
| North (W_127)       | 0             | 1                   |
| East (W_128)        | 0             | 1                   |
| West (W_129)        | 0             | 1                   |
| North (W_130)       | 0             | 1                   |
| North (W_131)       | 0             | 1                   |
| North (W_132)       | 0             | 1                   |
| East (W_133)        | 0             | 1                   |
| East (W_134)        | 0             | 1                   |
| West (W_135)        | 0             | 1                   |
| North (W_136)       | 0             | 1                   |

## Solar shading:

| <b>Orientation:</b> | <b>Z blinds:</b> | <b>Solar access:</b> | <b>Overhangs:</b> | <b>Z summer:</b> |             |
|---------------------|------------------|----------------------|-------------------|------------------|-------------|
| North (W_127)       | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| East (W_128)        | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| West (W_129)        | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| North (W_130)       | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| North (W_131)       | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| North (W_132)       | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| East (W_133)        | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| East (W_134)        | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| West (W_135)        | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |
| North (W_136)       | 0.85             | 0.9                  | 1                 | 0.76             | <b>(P8)</b> |

## Solar gains:

| <b>Orientation</b> |       | <b>Area</b> | <b>Flux</b> | <b>g<sub>g</sub></b> | <b>FF</b> | <b>Shading</b> | <b>Gains</b> |
|--------------------|-------|-------------|-------------|----------------------|-----------|----------------|--------------|
| North (W_127)      | 0.9 x | 0.54        | 82.12       | 0.63                 | 0.7       | 0.76           | 13.46        |
| East (W_128)       | 0.9 x | 1.48        | 119.47      | 0.63                 | 0.7       | 0.76           | 53.69        |
| West (W_129)       | 0.9 x | 1.54        | 119.47      | 0.63                 | 0.7       | 0.76           | 55.86        |
| North (W_130)      | 0.9 x | 0.74        | 82.12       | 0.63                 | 0.7       | 0.76           | 18.45        |

# SAP 2012 Overheating Assessment

|               |       |      |        |      |     |      |                       |
|---------------|-------|------|--------|------|-----|------|-----------------------|
| North (W_131) | 0.9 x | 0.96 | 82.12  | 0.63 | 0.7 | 0.76 | 23.94                 |
| North (W_132) | 0.9 x | 0.53 | 82.12  | 0.63 | 0.7 | 0.76 | 13.22                 |
| East (W_133)  | 0.9 x | 1.29 | 119.47 | 0.63 | 0.7 | 0.76 | 46.79                 |
| East (W_134)  | 0.9 x | 3.18 | 119.47 | 0.63 | 0.7 | 0.76 | 115.35                |
| West (W_135)  | 0.9 x | 1.5  | 119.47 | 0.63 | 0.7 | 0.76 | 54.41                 |
| North (W_136) | 0.9 x | 0.97 | 82.12  | 0.63 | 0.7 | 0.76 | 24.19                 |
| <b>Total</b>  |       |      |        |      |     |      | <b>419.37 (P3/P4)</b> |

## Internal gains:

|  | <b>June</b>            | <b>July</b>   | <b>August</b>      |
|--|------------------------|---------------|--------------------|
| Internal gains                                 | 410.23                 | 393.44        | 401.36             |
| Total summer gains                             | 856.85                 | 812.81        | 758.95 <b>(P5)</b> |
| Summer gain/loss ratio                         | 2.96                   | 2.81          | 2.62 <b>(P6)</b>   |
| Mean summer external temperature (East Anglia) | 15.4                   | 17.6          | 17.6               |
| Thermal mass temperature increment             | 1.3                    | 1.3           | 1.3                |
| Threshold temperature                          | 19.66                  | 21.71         | 21.52 <b>(P7)</b>  |
| <b>Likelihood of high internal temperature</b> | <b>Not significant</b> | <b>Slight</b> | <b>Slight</b>      |

**Assessment of likelihood of high internal temperature:** Slight