# 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 15:06:39*

## Project Information:

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

## Dwelling Details:

**NEW DWELLING DESIGN STAGE** Total Floor Area: 93.48m²

**Site Reference :** Bell Road, Bottisham **Plot Reference:** Plot 40

**Address :** Plot 40

## 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) | 16.56 kg/m² | |
| Dwelling Carbon Dioxide Emission Rate (DER) | 7.36 kg/m² | **OK** |

## 1b TFEE and DFEE

| | | |
|---|---|---|
| Target Fabric Energy Efficiency (TFEE) | 46.9 kWh/m² | |
| Dwelling Fabric Energy Efficiency (DFEE) | 42.2 kWh/m² | |
| | | **OK** |

## 2 Fabric U-values

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.19 (max. 0.30) | 0.19 (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 | 1.37 (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: Database: (rev 508, product index 018403):
Boiler systems with radiators or underfloor heating - mains gas
Brand name: Vaillant
Model: ecoFIT sustain 615
Model qualifier: VU 156/6-3 (H-GB)
(Regular)
Efficiency 89.8 % SEDBUK2009
Minimum 88.0 % **OK**

Secondary heating system: None

# Regulations Compliance Report

## 5 Cylinder insulation

| | | |
|---|---|---|
| Hot water Storage: | Measured cylinder loss: 1.32 kWh/day | |
| | Permitted by DBSCG: 2.30 kWh/day | **OK** |
| Primary pipework insulated: | Yes | **OK** |

## 6 Controls

| | | |
|---|---|---|
| Space heating controls | TTZC by plumbing and electrical services | **OK** |
| Hot water controls: | Cylinderstat | **OK** |
| | Independent timer for DHW | **OK** |
| 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: South West | 1.35m² |
| Windows facing: North East | 0.86m² |
| Windows facing: North East | 1.48m² |
| Windows facing: North East | 1.4m² |
| Windows facing: South West | 3.33m² |
| Windows facing: South West | 0.99m² |
| Windows facing: North West | 0.5m² |
| Windows facing: North West | 0.5m² |
| Windows facing: South West | 1.46m² |
| 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/m²K |
| Party Walls U-value | 0 W/m²K |
| Floors U-value | 0.11 W/m²K |
| Photovoltaic array | |

# Predicted Energy Assessment

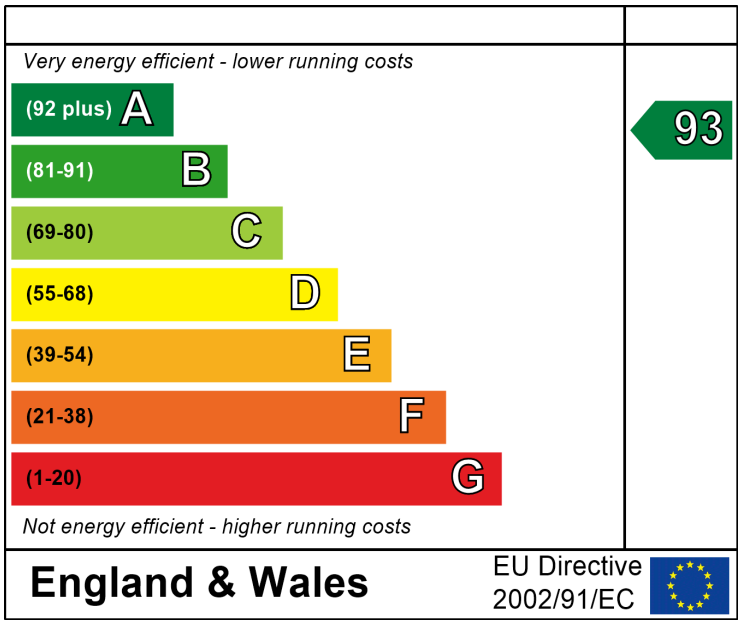
Plot 40

| | |
|---|---|
| Dwelling type: | Semi-detached House |
| Date of assessment: | 03 November 2022 |
| Produced by: | Liam Mason |
| Total floor area: | 93.48 m² |

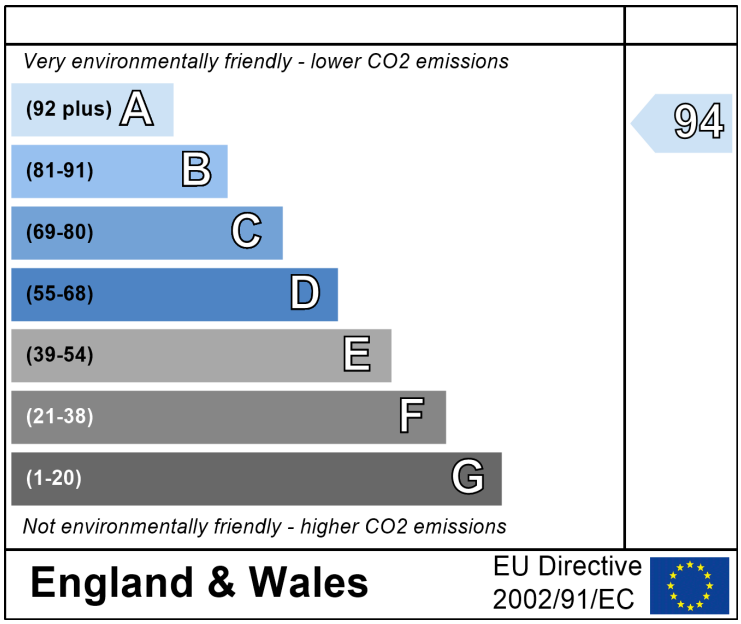
This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about 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 (CO2) emissions.

## Energy Efficiency Rating




## Environmental Impact ($CO_2$) Rating




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 (CO2) emissions. The higher the rating the less impact it has on the environment.

# SAP Input

## Property Details: Plot 40

| | |
|---|---|
| Address: | Plot 40 |
| 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 | 46.74 m² | 2.4 m |
| Floor 1 | 46.74 m² | 2.4 m |

| | |
|---|---|
| Living area: | 16.24 m² (fraction 0.174) |
| Front of dwelling faces: | North East |

## Opening types:

| Name: | Source: | Type: | Glazing: | Argon: | Frame: |
|---|---|---|---|---|---|
| D_12 | Manufacturer | Solid | | | |
| W_97 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_98 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_99 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_100 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_101 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_102 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_103 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_104 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |
| W_105 | Manufacturer | Windows | low-E, En = 0.05, soft coat | Yes | |

| **Name:** | **Gap:** | **Frame Factor:** | **g-value:** | **U-value:** | **Area:** | **No. of Openings:** |
|---|---|---|---|---|---|---|
| D_12 | mm | 0 | 0 | 1.2 | 2.03 | 1 |
| W_97 | 16mm or more | 0.7 | 0.63 | 1.4 | 1.35 | 1 |
| W_98 | 16mm or more | 0.7 | 0.63 | 1.4 | 0.86 | 1 |
| W_99 | 16mm or more | 0.7 | 0.63 | 1.4 | 1.48 | 1 |
| W_100 | 16mm or more | 0.7 | 0.63 | 1.4 | 1.4 | 1 |
| W_101 | 16mm or more | 0.7 | 0.63 | 1.4 | 3.33 | 1 |
| W_102 | 16mm or more | 0.7 | 0.63 | 1.4 | 0.99 | 1 |
| W_103 | 16mm or more | 0.7 | 0.63 | 1.4 | 0.5 | 1 |
| W_104 | 16mm or more | 0.7 | 0.63 | 1.4 | 0.5 | 1 |
| W_105 | 16mm or more | 0.7 | 0.63 | 1.4 | 1.46 | 1 |

| Name: | Type-Name: | Location: | Orient: | Width: | Height: |
|---|---|---|---|---|---|
| D_12 | Doors | Wall 1 | North East | 2.03 | 1 |
| W_97 | Windows | Wall 1 | South West | 1.35 | 1 |
| W_98 | Windows | Wall 1 | North East | 0.86 | 1 |
| W_99 | Windows | Wall 1 | North East | 1.48 | 1 |
| W_100 | Windows | Wall 1 | North East | 1.4 | 1 |

# SAP Input

| | | | | | |
|---|---|---|---|---|---|
| W_101 | Windows | Wall 1 | South West | 3.33 | 1 |
| W_102 | Windows | Wall 1 | South West | 0.99 | 1 |
| W_103 | Windows | Wall 1 | North West | 0.5 | 1 |
| W_104 | Windows | Wall 1 | North West | 0.5 | 1 |
| W_105 | Windows | Wall 1 | South West | 1.46 | 1 |

Overshading: Average or unknown

## Opaque Elements:

| Type: | Gross area: | Openings: | Net area: | U-value: | Ru value: | Curtain wall: | Kappa: |
|---|---|---|---|---|---|---|---|
| External Elements | | | | | | | |
| Wall 1 | 99.4 | 13.9 | 85.5 | 0.19 | 0 | False | N/A |
| Roof 1 | 46.74 | 0 | 46.74 | 0.11 | 0 | | N/A |
| Floor 1 | 46.74 | | | 0.11 | | | N/A |
| Internal Elements | | | | | | | |
| INT FLOOR | 46.74 | | | | | | N/A |
| Party Elements | | | | | | | |
| Party Wall | 43.5 | | | | | | N/A |

## Thermal bridges:

Thermal bridges: User-defined (individual PSI-values) Y-Value = 0.0744

| Length | Psi-value | | |
|---|---|---|---|
| 10.51 | 0.3 | E2 | Other lintels (including other steel lintels) |
| 7.89 | 0.04 | E3 | Sill |
| 25.3 | 0.05 | E4 | Jamb |
| 19.49 | 0.16 | E5 | Ground floor (normal) |
| 19.49 | 0.07 | E6 | Intermediate floor within a dwelling |
| 10.96 | 0.06 | E10 | Eaves (insulation at ceiling level) |
| 10.43 | 0.24 | E12 | Gable (insulation at ceiling level) |
| 10.2 | 0.09 | E16 | Corner (normal) |
| 10.2 | 0.06 | E18 | Party wall between dwellings |
| 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 | |
| 8.53 | 0 | P2 | Intermediate floor within a dwelling |
| 0 | 0.16 | P1 | Ground floor |
| 0 | 0.16 | P1 | |
| 0 | 0 | P2 | |
| 5.48 | 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: | 3 |
| Number of passive stacks: | 0 |
| Number of sides sheltered: | 2 |

# SAP Input

| | |
|---|---|
| Pressure test: | 5 |

## Main heating system:

| | |
|---|---|
| Main heating system: | Boiler systems with radiators or underfloor heating<br>Gas boilers and oil boilers<br>Fuel: mains gas<br>Info Source: Boiler Database<br>Database: (rev 508, product index 018403) Efficiency: Winter 80.1 % Summer: 90.8<br>Brand name: Vaillant<br>Model: ecoFIT sustain 615<br>Model qualifier: VU 156/6-3 (H-GB)<br>(Regular boiler)<br>Systems with radiators<br>Central heating pump : 2013 or later<br>Design flow temperature: Design flow temperature<=45°C<br>Unknown<br>Boiler interlock: Yes<br>Delayed start |

## Main heating Control:

| | |
|---|---|
| Main heating Control: | Time and temperature zone control by suitable arrangement of plumbing and electrical services<br>Control code: 2110 |

## Secondary heating system:

| | |
|---|---|
| Secondary heating system: | None |

## Water heating:

| | |
|---|---|
| Water heating: | From main heating system<br>Water code: 901<br>Fuel :mains gas<br>Hot water cylinder<br>Cylinder volume: 210 litres<br>Cylinder insulation: Measured loss, 1.32kWh/day<br>Primary pipework insulation: True<br>Cylinderstat: True<br>Cylinder in heated space: True<br>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<br>Installed Peak power: 2<br>Tilt of collector: 45°<br>Overshading: None or very little<br>Collector Orientation: South West |
| Assess Zero Carbon Home: | No |

# SAP WorkSheet: New dwelling design stage

## User Details:

| | | | |
|---|---|---|---|
| **Assessor Name:** | Liam Mason | **Stroma Number:** | STRO033679 |
| **Software Name:** | Stroma FSAP 2012 | **Software Version:** | Version: 1.0.5.58 |

## Property Address: Plot 40

**Address :** Plot 40

## 1. Overall dwelling dimensions:

| | Area(m²) | | Av. Height(m) | | Volume(m³) | |
|---|---|---|---|---|---|---|
| Ground floor | 46.74 | (1a) x | 2.4 | (2a) = | 112.18 | (3a) |
| First floor | 46.74 | (1b) x | 2.4 | (2b) = | 112.18 | (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n) | 93.48 | (4) | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) = | | 224.35 | (5) |

## 2. Ventilation rate:

| | main heating | | secondary heating | | other | | total | | m³ 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 | | | | | | | 3 | x 10 = | 30 | (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) = | 30 | ÷ (5) = | 0.13 (8) |

*If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)*

| | | | |
|---|---|---|---|
| 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 | | | 0 (11) |
| *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* | | | |
| 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) | | 0.38 (18) |
| *Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used* | | | |
| 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) = | | 0.33 (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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.42 | 0.41 | 0.4 | 0.36 | 0.35 | 0.31 | 0.31 | 0.3 | 0.33 | 0.35 | 0.37 | 0.38 |

*Calculate effective air change rate for the applicable case*

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × 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) × [1 – (23c) ÷ 100]

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

(24a)

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 |

(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

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

(24c)

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)m² x 0.5]

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (24d)m= | 0.59 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 |

(24d)

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (25)m= | 0.59 | 0.58 | 0.58 | 0.56 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 |

(25)

## 3. Heat losses and heat loss parameter:

| ELEMENT | Gross area (m²) | Openings m² | Net Area A ,m² | | U-value W/m2K | | A X U (W/K) | k-value kJ/m²·K | A X k kJ/K | |
|---|---|---|---|---|---|---|---|---|---|---|
| Doors | | | 2.03 | x | 1.2 | = | 2.436 | | | (26) |
| Windows Type 1 | | | 1.35 | x1/[1/( 1.4 )+ 0.04] | | = | 1.79 | | | (27) |
| Windows Type 2 | | | 0.86 | x1/[1/( 1.4 )+ 0.04] | | = | 1.14 | | | (27) |
| Windows Type 3 | | | 1.48 | x1/[1/( 1.4 )+ 0.04] | | = | 1.96 | | | (27) |
| Windows Type 4 | | | 1.4 | x1/[1/( 1.4 )+ 0.04] | | = | 1.86 | | | (27) |
| Windows Type 5 | | | 3.33 | x1/[1/( 1.4 )+ 0.04] | | = | 4.41 | | | (27) |
| Windows Type 6 | | | 0.99 | x1/[1/( 1.4 )+ 0.04] | | = | 1.31 | | | (27) |
| Windows Type 7 | | | 0.5 | x1/[1/( 1.4 )+ 0.04] | | = | 0.66 | | | (27) |
| Windows Type 8 | | | 0.5 | x1/[1/( 1.4 )+ 0.04] | | = | 0.66 | | | (27) |
| Windows Type 9 | | | 1.46 | x1/[1/( 1.4 )+ 0.04] | | = | 1.94 | | | (27) |
| Floor | | | 46.74 | x | 0.11 | = | 5.1414 | | | (28) |
| Walls | 99.4 | 13.9 | 85.5 | x | 0.19 | = | 16.25 | | | (29) |
| Roof | 46.74 | 0 | 46.74 | x | 0.11 | = | 5.14 | | | (30) |
| Total area of elements, m² | | | 192.88 | | | | | | | (31) |
| Party wall | | | 43.5 | x | 0 | = | 0 | | | (32) |
| Internal floor | | | 46.74 | | | | | | | (32d) |

** 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) = 44.7 (33)

# SAP WorkSheet: New dwelling design stage

Heat capacity Cm = S(A x k ) ((28)…(30) + (32) + (32a)…(32e) = 20098.38 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Low 100 (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 x Y) calculated using Appendix K 14.35 (36)

*if details of thermal bridging are not known (36) = 0.05 x (31)*

Total fabric heat loss (33) + (36) = 59.05 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m= | 43.42 | 43.17 | 42.93 | 41.78 | 41.57 | 40.57 | 40.57 | 40.39 | 40.96 | 41.57 | 42 | 42.46 | (38) |

Heat transfer coefficient, W/K (39)m = (37) + (38)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (39)m= | 102.47 | 102.22 | 101.97 | 100.83 | 100.61 | 99.62 | 99.62 | 99.43 | 100 | 100.61 | 101.05 | 101.5 | |

Average = Sum(39)$_{1...12}$ /12= 100.83 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (40)m= | 1.1 | 1.09 | 1.09 | 1.08 | 1.08 | 1.07 | 1.07 | 1.06 | 1.07 | 1.08 | 1.08 | 1.09 | |

Average = Sum(40)$_{1...12}$ /12= 1.08 (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 2.67 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 97.62 (43)

*Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)*

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)* | | | | | | | | | | | | | |
| (44)m= | 107.38 | 103.48 | 99.57 | 95.67 | 91.77 | 87.86 | 87.86 | 91.77 | 95.67 | 99.57 | 103.48 | 107.38 | |

Total = Sum(44)$_{1...12}$ = 1171.47 (44)

*Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)*

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (45)m= | 159.25 | 139.28 | 143.72 | 125.3 | 120.23 | 103.75 | 96.14 | 110.32 | 111.64 | 130.1 | 142.02 | 154.22 | |

Total = Sum(45)$_{1...12}$ = 1535.98 (45)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (46)m= | 23.89 | 20.89 | 21.56 | 18.8 | 18.03 | 15.56 | 14.42 | 16.55 | 16.75 | 19.52 | 21.3 | 23.13 | (46) |

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 210 (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): 1.32 (48)

Temperature factor from Table 2b 0.54 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0.71 (50)

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

# SAP WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| 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) | | 0.71 | (55) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (56)m= | 22.1 | 19.96 | 22.1 | 21.38 | 22.1 | 21.38 | 22.1 | 22.1 | 21.38 | 22.1 | 21.38 | 22.1 | (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= | 22.1 | 19.96 | 22.1 | 21.38 | 22.1 | 21.38 | 22.1 | 22.1 | 21.38 | 22.1 | 21.38 | 22.1 | (57) |

| | | |
|---|---|---|
| Primary circuit loss (annual) from Table 3 | 0 | (58) |

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (59)m= | 23.26 | 21.01 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | 23.26 | 22.51 | 23.26 | 22.51 | 23.26 | (59) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (61)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | (61) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (62)m= | 204.61 | 180.25 | 189.08 | 169.2 | 165.59 | 147.65 | 141.5 | 155.68 | 155.53 | 175.46 | 185.92 | 199.58 | (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= | 204.61 | 180.25 | 189.08 | 169.2 | 165.59 | 147.65 | 141.5 | 155.68 | 155.53 | 175.46 | 185.92 | 199.58 | |

Output from water heater (annual)$_{1...12}$ 2070.05 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m ]

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (65)m= | 89.24 | 79.09 | 84.08 | 76.78 | 76.26 | 69.61 | 68.25 | 72.97 | 72.24 | 79.55 | 82.34 | 87.57 | (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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m= | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | 160.23 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (67)m= | 59.94 | 53.24 | 43.29 | 32.78 | 24.5 | 20.68 | 22.35 | 29.05 | 38.99 | 49.51 | 57.79 | 61.6 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (68)m= | 366.17 | 369.97 | 360.4 | 340.01 | 314.28 | 290.1 | 273.94 | 270.14 | 279.72 | 300.1 | 325.83 | 350.02 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (69)m= | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | 53.69 | (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= | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | -106.82 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (72)m= | 119.94 | 117.69 | 113 | 106.64 | 102.51 | 96.69 | 91.74 | 98.08 | 100.33 | 106.92 | 114.36 | 117.7 | (72) |

# SAP WorkSheet: New dwelling design stage

**Total internal gains =** (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (73)m= | 656.15 | 651 | 626.8 | 589.53 | 551.39 | 517.57 | 498.13 | 507.37 | 529.14 | 566.63 | 608.08 | 639.42 |

(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 Table 6d | | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast 0.9x | 0.77 | x | 0.86 | x | 11.28 | x | 0.63 | x | 0.7 | = | 2.97 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 11.28 | x | 0.63 | x | 0.7 | = | 5.1 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 11.28 | x | 0.63 | x | 0.7 | = | 4.83 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 22.97 | x | 0.63 | x | 0.7 | = | 6.04 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 22.97 | x | 0.63 | x | 0.7 | = | 10.39 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 22.97 | x | 0.63 | x | 0.7 | = | 9.83 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 41.38 | x | 0.63 | x | 0.7 | = | 10.88 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 41.38 | x | 0.63 | x | 0.7 | = | 18.72 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 41.38 | x | 0.63 | x | 0.7 | = | 17.7 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 67.96 | x | 0.63 | x | 0.7 | = | 17.86 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 67.96 | x | 0.63 | x | 0.7 | = | 30.74 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 67.96 | x | 0.63 | x | 0.7 | = | 29.08 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 91.35 | x | 0.63 | x | 0.7 | = | 24.01 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 91.35 | x | 0.63 | x | 0.7 | = | 41.32 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 91.35 | x | 0.63 | x | 0.7 | = | 39.08 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 97.38 | x | 0.63 | x | 0.7 | = | 25.6 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 97.38 | x | 0.63 | x | 0.7 | = | 44.05 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 97.38 | x | 0.63 | x | 0.7 | = | 41.67 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 91.1 | x | 0.63 | x | 0.7 | = | 23.94 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 91.1 | x | 0.63 | x | 0.7 | = | 41.21 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 91.1 | x | 0.63 | x | 0.7 | = | 38.98 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 72.63 | x | 0.63 | x | 0.7 | = | 19.09 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 72.63 | x | 0.63 | x | 0.7 | = | 32.85 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 72.63 | x | 0.63 | x | 0.7 | = | 31.07 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 50.42 | x | 0.63 | x | 0.7 | = | 13.25 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 50.42 | x | 0.63 | x | 0.7 | = | 22.81 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 50.42 | x | 0.63 | x | 0.7 | = | 21.57 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 28.07 | x | 0.63 | x | 0.7 | = | 7.38 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.69 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 28.07 | x | 0.63 | x | 0.7 | = | 12.01 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 14.2 | x | 0.63 | x | 0.7 | = | 3.73 | (75) |
| Northeast 0.9x | 0.77 | x | 1.48 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.42 | (75) |
| Northeast 0.9x | 0.77 | x | 1.4 | x | 14.2 | x | 0.63 | x | 0.7 | = | 6.07 | (75) |
| Northeast 0.9x | 0.77 | x | 0.86 | x | 9.21 | x | 0.63 | x | 0.7 | = | 2.42 | (75) |

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| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | 0.9x | 0.77 | x | 1.48 | x | 9.21 | x | 0.63 | x | 0.7 | = | 4.17 | (75) |
| Northeast | 0.9x | 0.77 | x | 1.4 | x | 9.21 | x | 0.63 | x | 0.7 | = | 3.94 | (75) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 36.79 | | 0.63 | x | 0.7 | = | 15.18 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 36.79 | | 0.63 | x | 0.7 | = | 37.44 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 36.79 | | 0.63 | x | 0.7 | = | 11.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 36.79 | | 0.63 | x | 0.7 | = | 16.42 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 62.67 | | 0.63 | x | 0.7 | = | 25.86 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 62.67 | | 0.63 | x | 0.7 | = | 63.78 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 62.67 | | 0.63 | x | 0.7 | = | 18.96 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 62.67 | | 0.63 | x | 0.7 | = | 27.96 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 85.75 | | 0.63 | x | 0.7 | = | 35.38 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 85.75 | | 0.63 | x | 0.7 | = | 87.27 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 85.75 | | 0.63 | x | 0.7 | = | 25.95 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 85.75 | | 0.63 | x | 0.7 | = | 38.26 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 106.25 | | 0.63 | x | 0.7 | = | 43.84 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 106.25 | | 0.63 | x | 0.7 | = | 108.13 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 106.25 | | 0.63 | x | 0.7 | = | 32.15 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 106.25 | | 0.63 | x | 0.7 | = | 47.41 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 119.01 | | 0.63 | x | 0.7 | = | 49.1 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 119.01 | | 0.63 | x | 0.7 | = | 121.12 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 119.01 | | 0.63 | x | 0.7 | = | 36.01 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 119.01 | | 0.63 | x | 0.7 | = | 53.1 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 118.15 | | 0.63 | x | 0.7 | = | 48.75 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 118.15 | | 0.63 | x | 0.7 | = | 120.24 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 118.15 | | 0.63 | x | 0.7 | = | 35.75 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 118.15 | | 0.63 | x | 0.7 | = | 52.72 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 113.91 | | 0.63 | x | 0.7 | = | 47 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 113.91 | | 0.63 | x | 0.7 | = | 115.92 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 113.91 | | 0.63 | x | 0.7 | = | 34.46 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 113.91 | | 0.63 | x | 0.7 | = | 50.83 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 104.39 | | 0.63 | x | 0.7 | = | 43.07 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 104.39 | | 0.63 | x | 0.7 | = | 106.24 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 104.39 | | 0.63 | x | 0.7 | = | 31.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 104.39 | | 0.63 | x | 0.7 | = | 46.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 92.85 | | 0.63 | x | 0.7 | = | 38.31 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 92.85 | | 0.63 | x | 0.7 | = | 94.49 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 92.85 | | 0.63 | x | 0.7 | = | 28.09 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 92.85 | | 0.63 | x | 0.7 | = | 41.43 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 69.27 | | 0.63 | x | 0.7 | = | 28.58 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 69.27 | | 0.63 | x | 0.7 | = | 70.49 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 69.27 | | 0.63 | x | 0.7 | = | 20.96 | (79) |

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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 69.27 | | 0.63 | x | 0.7 | = | 30.91 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 44.07 | | 0.63 | x | 0.7 | = | 18.18 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 44.07 | | 0.63 | x | 0.7 | = | 44.85 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 44.07 | | 0.63 | x | 0.7 | = | 13.33 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 44.07 | | 0.63 | x | 0.7 | = | 19.66 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.35 | x | 31.49 | | 0.63 | x | 0.7 | = | 12.99 | (79) |
| Southwest | 0.9x | 0.77 | x | 3.33 | x | 31.49 | | 0.63 | x | 0.7 | = | 32.04 | (79) |
| Southwest | 0.9x | 0.77 | x | 0.99 | x | 31.49 | | 0.63 | x | 0.7 | = | 9.53 | (79) |
| Southwest | 0.9x | 0.77 | x | 1.46 | x | 31.49 | | 0.63 | x | 0.7 | = | 14.05 | (79) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.72 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 11.28 | x | 0.63 | x | 0.7 | = | 1.72 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 22.97 | x | 0.63 | x | 0.7 | = | 3.51 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 22.97 | x | 0.63 | x | 0.7 | = | 3.51 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 41.38 | x | 0.63 | x | 0.7 | = | 6.32 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 41.38 | x | 0.63 | x | 0.7 | = | 6.32 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 67.96 | x | 0.63 | x | 0.7 | = | 10.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 67.96 | x | 0.63 | x | 0.7 | = | 10.38 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 91.35 | x | 0.63 | x | 0.7 | = | 13.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 91.35 | x | 0.63 | x | 0.7 | = | 13.96 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 97.38 | x | 0.63 | x | 0.7 | = | 14.88 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 97.38 | x | 0.63 | x | 0.7 | = | 14.88 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 91.1 | x | 0.63 | x | 0.7 | = | 13.92 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 91.1 | x | 0.63 | x | 0.7 | = | 13.92 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 72.63 | x | 0.63 | x | 0.7 | = | 11.1 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 72.63 | x | 0.63 | x | 0.7 | = | 11.1 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 50.42 | x | 0.63 | x | 0.7 | = | 7.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 50.42 | x | 0.63 | x | 0.7 | = | 7.7 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.29 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 28.07 | x | 0.63 | x | 0.7 | = | 4.29 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 14.2 | x | 0.63 | x | 0.7 | = | 2.17 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.41 | (81) |
| Northwest | 0.9x | 0.77 | x | 0.5 | x | 9.21 | x | 0.63 | x | 0.7 | = | 1.41 | (81) |

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (83)m= | 96.52 | 169.84 | 246.8 | 329.97 | 391.65 | 398.52 | 380.18 | 332.68 | 275.37 | 191.59 | 116.6 | 81.96 | (83) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (84)m= | 752.67 | 820.83 | 873.6 | 919.5 | 943.04 | 916.09 | 878.31 | 840.05 | 804.51 | 758.23 | 724.68 | 721.38 | (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 |
|---|---|---|---|---|---|---|---|---|---|---|---|

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (86)m= | 0.94 | 0.92 | 0.88 | 0.82 | 0.73 | 0.59 | 0.46 | 0.49 | 0.67 | 0.84 | 0.91 | 0.94 | (86) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (87)m= | 19.04 | 19.26 | 19.62 | 20.09 | 20.51 | 20.81 | 20.93 | 20.91 | 20.71 | 20.19 | 19.54 | 18.99 | (87) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (88)m= | 20 | 20.01 | 20.01 | 20.02 | 20.02 | 20.03 | 20.03 | 20.03 | 20.03 | 20.02 | 20.02 | 20.01 | (88) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (89)m= | 0.93 | 0.91 | 0.87 | 0.8 | 0.69 | 0.52 | 0.37 | 0.4 | 0.61 | 0.81 | 0.9 | 0.93 | (89) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (90)m= | 17.4 | 17.72 | 18.24 | 18.91 | 19.47 | 19.85 | 19.98 | 19.97 | 19.74 | 19.05 | 18.14 | 17.35 | (90) |

fLA = Living area ÷ (4) = 0.17 (91)

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (92)m= | 17.69 | 17.99 | 18.48 | 19.11 | 19.65 | 20.02 | 20.15 | 20.13 | 19.91 | 19.25 | 18.38 | 17.63 | (92) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (93)m= | 17.54 | 17.84 | 18.33 | 18.96 | 19.5 | 19.87 | 20 | 19.98 | 19.76 | 19.1 | 18.23 | 17.48 | (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 | 0.77 | 0.66 | 0.51 | 0.37 | 0.4 | 0.59 | 0.77 | 0.87 | 0.91 | (94) |
| Useful gains, hmGm , W = (94)m x (84)m | | | | | | | | | | | | | |
| (95)m= | 675.11 | 716.78 | 728.81 | 704.25 | 623.66 | 469.19 | 322.68 | 335.93 | 477.97 | 586.61 | 627.52 | 652.85 | (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= | 1356.39 | 1322.37 | 1206.37 | 1014.81 | 785.29 | 524.95 | 338.4 | 356.31 | 565.76 | 855.44 | 1125.11 | 1348.09 | (97) |
| Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m | | | | | | | | | | | | | |
| (98)m= | 506.87 | 406.96 | 355.31 | 223.6 | 120.26 | 0 | 0 | 0 | 0 | 200.01 | 358.27 | 517.26 | |

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2688.52 (98)

Space heating requirement in kWh/m²/year 28.76 (99)

## 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 93.2 (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) | | | | | | | | | | | | | |
| | 506.87 | 406.96 | 355.31 | 223.6 | 120.26 | 0 | 0 | 0 | 0 | 200.01 | 358.27 | 517.26 | |
| (211)m = {[(98)m x (204)] } x 100 ÷ (206) | | | | | | | | | | | | | (211) |
| | 543.85 | 436.65 | 381.23 | 239.91 | 129.03 | 0 | 0 | 0 | 0 | 214.6 | 384.41 | 555 | |

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2884.68 (211)

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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)$_{1...5,10...12}$= 0 (215)

**Water heating**

Output from water heater (calculated above)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 204.61 | 180.25 | 189.08 | 169.2 | 165.59 | 147.65 | 141.5 | 155.68 | 155.53 | 175.46 | 185.92 | 199.58 |

Efficiency of water heater 80.1 (216)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (217)m= | 87.44 | 87.22 | 86.77 | 85.86 | 84.28 | 80.1 | 80.1 | 80.1 | 80.1 | 85.46 | 86.84 | 87.54 |

(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (219)m= | 234 | 206.65 | 217.9 | 197.06 | 196.48 | 184.33 | 176.65 | 194.36 | 194.18 | 205.31 | 214.1 | 227.98 |

Total = Sum(219a)$_{1...12}$ = 2448.99 (219)

| **Annual totals** | **kWh/year** | **kWh/year** |
|---|---|---|
| Space heating fuel used, main system 1 | | 2884.68 |
| Water heating fuel used | | 2448.99 |
| 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 | | 423.4 (232) |
| Electricity generated by PVs | | -1606.39 (233) |
| Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = | | 4225.68 (338) |

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

| | **Fuel** kWh/year | **Fuel Price** (Table 12) | **Fuel Cost** £/year |
|---|---|---|---|
| Space heating - main system 1 | (211) x | 3.48 x 0.01 = | 100.39 (240) |
| Space heating - main system 2 | (213) x | 0 x 0.01 = | 0 (241) |
| Space heating - secondary | (215) x | 13.19 x 0.01 = | 0 (242) |
| Water heating cost (other fuel) | (219) | 3.48 x 0.01 = | 85.22 (247) |
| Pumps, fans and electric keep-hot | (231) | 13.19 x 0.01 = | 9.89 (249) |
| (if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a | | | |
| Energy for lighting | (232) | 13.19 x 0.01 = | 55.85 (250) |
| Additional standing charges (Table 12) | | | 120 (251) |
| | one of (233) to (235) x) | 13.19 x 0.01 = | -211.88 (252) |

Appendix Q items: repeat lines (253) and (254) as needed

**Total energy cost** (245)...(247) + (250)…(254) = 159.47 (255)

## 11a. SAP rating - individual heating systems

Energy cost deflator (Table 12) 0.42 (256)

# SAP WorkSheet: New dwelling design stage

| | | | |
|---|---|---|---|
| Energy cost factor (ECF) | [(255) x (256)] ÷ [(4) + 45.0] = | 0.48 | (257) |
| **SAP rating (Section 12)** | | 93.25 | (258) |

## 12a. CO2 emissions – Individual heating systems including micro-CHP

| | | **Energy** kWh/year | | **Emission factor** kg CO2/kWh | | **Emissions** kg CO2/year | |
|---|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | | 0.216 | = | 623.09 | (261) |
| Space heating (secondary) | (215) | x | | 0.519 | = | 0 | (263) |
| Water heating | (219) | x | | 0.216 | = | 528.98 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | | 1152.07 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | | 0.519 | = | 38.93 | (267) |
| Electricity for lighting | (232) | x | | 0.519 | = | 219.74 | (268) |
| Energy saving/generation technologies Item 1 | | | | 0.519 | = | -833.72 | (269) |
| Total CO2, kg/year | | | sum of (265)…(271) = | | | 577.02 | (272) |
| **CO2 emissions per m²** | | | (272) ÷ (4) = | | | 6.17 | (273) |
| EI rating (section 14) | | | | | | 94 | (274) |

## 13a. Primary Energy

| | | **Energy** kWh/year | | **Primary** factor | | **P. Energy** kWh/year | |
|---|---|---|---|---|---|---|---|
| Space heating (main system 1) | (211) | x | | 1.22 | = | 3519.31 | (261) |
| Space heating (secondary) | (215) | x | | 3.07 | = | 0 | (263) |
| Energy for water heating | (219) | x | | 1.22 | = | 2987.77 | (264) |
| Space and water heating | (261) + (262) + (263) + (264) = | | | | | 6507.08 | (265) |
| Electricity for pumps, fans and electric keep-hot | (231) | x | | 3.07 | = | 230.25 | (267) |
| Electricity for lighting | (232) | x | | 0 | = | 1299.84 | (268) |
| Energy saving/generation technologies Item 1 | | | | 3.07 | = | -4931.63 | (269) |
| 'Total Primary Energy | | | sum of (265)…(271) = | | | 3105.54 | (272) |
| **Primary energy kWh/m²/year** | | | (272) ÷ (4) = | | | 33.22 | (273) |

# SAP 2012 Overheating Assessment

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

## Property Details: Plot 40

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

## Overheating Details:

| | | |
|---|---|---|
| **Summer ventilation heat loss coefficient:** | 296.14 | **(P1)** |
| **Transmission heat loss coefficient:** | 59 | |
| **Summer heat loss coefficient:** | 355.19 | **(P2)** |

## Overhangs:

| Orientation: | Ratio: | Z_overhangs: |
|---|---|---|
| South West (W_97) | 0 | 1 |
| North East (W_98) | 0 | 1 |
| North East (W_99) | 0 | 1 |
| North East (W_100) | 0 | 1 |
| South West (W_101) | 0 | 1 |
| South West (W_102) | 0 | 1 |
| North West (W_103) | 0 | 1 |
| North West (W_104) | 0 | 1 |
| South West (W_105) | 0 | 1 |

## Solar shading:

| Orientation: | Z blinds: | Solar access: | Overhangs: | Z summer: | |
|---|---|---|---|---|---|
| South West (W_97) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| North East (W_98) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| North East (W_99) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| North East (W_100) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| South West (W_101) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| South West (W_102) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| North West (W_103) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| North West (W_104) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |
| South West (W_105) | 0.85 | 0.9 | 1 | 0.76 | **(P8)** |

## Solar gains:

| Orientation | | Area | Flux | g_ | FF | Shading | Gains |
|---|---|---|---|---|---|---|---|
| South West (W_97) | 0.9 x | 1.35 | 122.31 | 0.63 | 0.7 | 0.76 | 50.14 |
| North East (W_98) | 0.9 x | 0.86 | 100.04 | 0.63 | 0.7 | 0.76 | 26.12 |
| North East (W_99) | 0.9 x | 1.48 | 100.04 | 0.63 | 0.7 | 0.76 | 44.96 |
| North East (W_100) | 0.9 x | 1.4 | 100.04 | 0.63 | 0.7 | 0.76 | 42.53 |
| South West (W_101) | 0.9 x | 3.33 | 122.31 | 0.63 | 0.7 | 0.76 | 123.67 |
| South West (W_102) | 0.9 x | 0.99 | 122.31 | 0.63 | 0.7 | 0.76 | 36.77 |

# SAP 2012 Overheating Assessment

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| North West (W_103) | 0.9 x | 0.5 | 100.04 | 0.63 | 0.7 | 0.76 | 15.19 | |
| North West (W_104) | 0.9 x | 0.5 | 100.04 | 0.63 | 0.7 | 0.76 | 15.19 | |
| South West (W_105) | 0.9 x | 1.46 | 122.31 | 0.63 | 0.7 | 0.76 | 54.22 | |
| | | | | | | **Total** | 408.77 | **(P3/P4)** |

## Internal gains:

| | **June** | **July** | **August** | |
|---|---|---|---|---|
| Internal gains | 514.57 | 495.13 | 504.37 | |
| Total summer gains | 947.44 | 903.91 | 864.36 | **(P5)** |
| Summer gain/loss ratio | 2.67 | 2.54 | 2.43 | **(P6)** |
| Mean summer external temperature (East Anglia) | 15.4 | 17.6 | 17.6 | |
| Thermal mass temperature increment | 1.3 | 1.3 | 1.3 | |
| Threshold temperature | 19.37 | 21.44 | 21.33 | **(P7)** |
| **Likelihood of high internal temperature** | **Not significant** | **Slight** | **Slight** | |

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