

# Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Fri 15 Nov 2024 10:34:18

| Project Information |                   |                 |                      |
|---------------------|-------------------|-----------------|----------------------|
| Assessed By         | Victoria Gartside | Building Type   | House, Semi-detached |
| OCDEA Registration  | EES/026678        | Assessment Date | 2024-11-15           |

| Dwelling Details |                |                  |                    |
|------------------|----------------|------------------|--------------------|
| Assessment Type  | As designed    | Total Floor Area | 106 m <sup>2</sup> |
| Site Reference   | SAP VG 21-0282 | Plot Reference   | Plot 54            |
| Address          |                |                  |                    |

| Client Details |                                                     |
|----------------|-----------------------------------------------------|
| Name           | Newett Homes                                        |
| Company        | Newett Homes                                        |
| Address        | Thorp Arch Grange , Thorp Arch, Wetherby , Wetherby |

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

| 1a Target emission rate and dwelling emission rate |                                         |    |
|----------------------------------------------------|-----------------------------------------|----|
| Fuel for main heating system                       | Mains gas                               |    |
| Target carbon dioxide emission rate                | 12.86 kgCO <sub>2</sub> /m <sup>2</sup> |    |
| Dwelling carbon dioxide emission rate              | 12.81 kgCO <sub>2</sub> /m <sup>2</sup> | OK |

| 1b Target primary energy rate and dwelling primary energy |                                         |    |
|-----------------------------------------------------------|-----------------------------------------|----|
| Target primary energy                                     | 67.52 kWh <sub>PE</sub> /m <sup>2</sup> |    |
| Dwelling primary energy                                   | 67.36 kWh <sub>PE</sub> /m <sup>2</sup> | OK |

| 1c Target fabric energy efficiency and dwelling fabric energy efficiency |                         |    |
|--------------------------------------------------------------------------|-------------------------|----|
| Target fabric energy efficiency                                          | 44.1 kWh/m <sup>2</sup> |    |
| Dwelling fabric energy efficiency                                        | 41.5 kWh/m <sup>2</sup> | OK |

| 2a Fabric U-values               |                                                        |                                               |                                         |     |
|----------------------------------|--------------------------------------------------------|-----------------------------------------------|-----------------------------------------|-----|
| Element                          | Maximum permitted average U-Value [W/m <sup>2</sup> K] | Dwelling average U-Value [W/m <sup>2</sup> K] | Element with highest individual U-Value |     |
| External walls                   | 0.26                                                   | 0.18                                          | Walls (1) (0.19)                        | OK  |
| Party walls                      | 0.2                                                    | 0                                             | Party Wall (1) (0)                      | N/A |
| Curtain walls                    | 1.6                                                    | 0                                             | N/A                                     | N/A |
| Floors                           | 0.18                                                   | 0.16                                          | Exposed floor (0.2)                     | OK  |
| Roofs                            | 0.16                                                   | 0.09                                          | Roof (1) (0.09)                         | OK  |
| Windows, doors, and roof windows | 1.6                                                    | 1.28                                          | Front windows brick (1.3)               | OK  |
| Rooflights                       | 2.2                                                    | N/A                                           | N/A                                     | N/A |

| 2b Envelope elements (better than typically expected values are flagged with a subsequent (!)) |                            |                              |
|------------------------------------------------------------------------------------------------|----------------------------|------------------------------|
| Name                                                                                           | Net area [m <sup>2</sup> ] | U-Value [W/m <sup>2</sup> K] |
| Exposed wall: Walls (1)                                                                        | 108.11                     | 0.19                         |
| Exposed wall: Walls (2)                                                                        | 12.92                      | 0.18                         |
| Sheltered wall: Walls (3)                                                                      | 21.32                      | 0.14 (!)                     |
| Party wall: Party Wall (1)                                                                     | 69.14                      | 0 (!)                        |
| Ground floor: Ground floor , Ground floor                                                      | 25.41                      | 0.13                         |
| Upper floor: Exposed floor , Exposed floor                                                     | 14.76                      | 0.2                          |
| Exposed roof: Roof (1)                                                                         | 40.18                      | 0.09 (!)                     |

| 2c Openings (better than typically expected values are flagged with a subsequent (!)) |                        |             |              |                              |
|---------------------------------------------------------------------------------------|------------------------|-------------|--------------|------------------------------|
| Name                                                                                  | Area [m <sup>2</sup> ] | Orientation | Frame factor | U-Value [W/m <sup>2</sup> K] |
| Front door, Solid front door                                                          | 2.14                   | West        | N/A          | 1.1 (!)                      |
| Front windows brick, Windows                                                          | 7                      | West        | 0.7          | 1.3                          |
| Side windows brick, Windows                                                           | 1.42                   | North       | 0.7          | 1.3                          |
| Rear windows brick, Windows                                                           | 7.21                   | East        | 0.7          | 1.3                          |

| 2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))                     |  |
|-------------------------------------------------------------------------------------------------------------------|--|
| Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction |  |

| Main element  | Junction detail                                                   | Source                                       | Psi value [W/mK] | Drawing / reference      |
|---------------|-------------------------------------------------------------------|----------------------------------------------|------------------|--------------------------|
| External wall | E2: Other lintels (including other steel lintels)                 | Calculated by person with suitable expertise | 0.024 (!)        | MFF-150-E2-02            |
| External wall | E3: Sill                                                          | Calculated by person with suitable expertise | 0.022 (!)        | MFF-150-E3-01            |
| External wall | E4: Jamb                                                          | Calculated by person with suitable expertise | 0.017 (!)        | MFF-150-E4-01            |
| External wall | E5: Ground floor (normal)                                         | Calculated by person with suitable expertise | 0.092            | Manufacturer Declaration |
| External wall | E6: Intermediate floor within a dwelling                          | Calculated by person with suitable expertise | 0.001 (!)        | MFF-150-E6-01            |
| External wall | E10: Eaves (insulation at ceiling level)                          | Calculated by person with suitable expertise | 0.06             | MFF-150-E10-01           |
| External wall | E12: Gable (insulation at ceiling level)                          | Calculated by person with suitable expertise | 0.056            | MFF-150-E12-01           |
| External wall | E16: Corner (normal)                                              | Calculated by person with suitable expertise | 0.046            | MFF-150-E16-01           |
| External wall | E17: Corner (inverted - internal area greater than external area) | Calculated by person with suitable expertise | -0.088           | MFF-150-E17-01           |
| External wall | E20: Exposed floor (normal)                                       | Calculated by person with suitable expertise | 0.069            | MFF-150-E20-01           |
| External wall | E21: Exposed floor (inverted)                                     | SAP table default                            | 0.32             |                          |
| External wall | E18: Party wall between dwellings                                 | Calculated by person with suitable expertise | 0.038 (!)        | MFF-150-E18-04           |
| Party wall    | P1: Ground floor                                                  | Calculated by person with suitable expertise | 0.069            | Manufacturer Declaration |
| Party wall    | P2: Intermediate floor within a dwelling                          | SAP table default                            | 0 (!)            |                          |
| Party wall    | P4: Roof (insulation at ceiling level)                            | SAP table default                            | 0.48             |                          |

### 3 Air permeability (better than typically expected values are flagged with a subsequent (!))

|                                             |                                                  |    |
|---------------------------------------------|--------------------------------------------------|----|
| Maximum permitted air permeability at 50Pa  | 8 m <sup>3</sup> /hm <sup>2</sup>                |    |
| Dwelling air permeability at 50Pa           | 4 m <sup>3</sup> /hm <sup>2</sup> , Design value | OK |
| Air permeability test certificate reference |                                                  |    |

### 4 Space heating

#### Main heating system 1: Boiler with radiators or underfloor heating - Mains gas

|                  |                               |
|------------------|-------------------------------|
| Efficiency       | 88.6%                         |
| Emitter type     | Both radiators and underfloor |
| Flow temperature |                               |
| System type      | Combi boiler                  |
| Manufacturer     | Vaillant                      |
| Model            | ecoTEC sustain 34             |
| Commissioning    |                               |

#### Secondary heating system: N/A

|               |     |
|---------------|-----|
| Fuel          | N/A |
| Efficiency    | N/A |
| Commissioning |     |

### 5 Hot water

#### Cylinder/store - type: N/A

|                            |     |
|----------------------------|-----|
| Capacity                   | N/A |
| Declared heat loss         | N/A |
| Primary pipework insulated | N/A |
| Manufacturer               |     |
| Model                      |     |
| Commissioning              |     |

#### Waste water heat recovery system 1 - type: N/A

|              |  |
|--------------|--|
| Efficiency   |  |
| Manufacturer |  |
| Model        |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----|
| <b>6 Controls</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |     |
| <b>Main heating 1</b> - type: Time and temperature zone control by arrangement of plumbing and electrical services                                                                                                                                                                                                                                                                                                                                                                               |                     |     |
| Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |     |
| Ecodesign class                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |     |
| Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |     |
| Model                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |     |
| <b>Water heating</b> - type: N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                     |     |
| Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |     |
| Model                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |     |
| <b>7 Lighting</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |     |
| Minimum permitted light source efficacy                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 75 lm/W             |     |
| Lowest light source efficacy                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 85 lm/W             | OK  |
| External lights control                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | N/A                 |     |
| <b>8 Mechanical ventilation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |     |
| <b>System type:</b> N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |     |
| Maximum permitted specific fan power                                                                                                                                                                                                                                                                                                                                                                                                                                                             | N/A                 |     |
| Specific fan power                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | N/A                 | N/A |
| Minimum permitted heat recovery efficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                       | N/A                 |     |
| Heat recovery efficiency                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | N/A                 | N/A |
| Manufacturer/Model                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |     |
| Commissioning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                     |     |
| <b>9 Local generation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |     |
| Technology type: <b>Photovoltaic system (1)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |     |
| Peak power                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2.43 kWp            |     |
| Orientation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | East                |     |
| Pitch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 30°                 |     |
| Overshading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | None or very little |     |
| Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | PV                  |     |
| MCS certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |     |
| Technology type: <b>Photovoltaic system (2)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |     |
| Peak power                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.6 kWp             |     |
| Orientation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | West                |     |
| Pitch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 30°                 |     |
| Overshading                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | None or very little |     |
| Manufacturer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Front panels        |     |
| MCS certificate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |     |
| <b>10 Heat networks</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                     |     |
| N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |     |
| <b>11 Supporting documentary evidence</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |     |
| N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |     |
| <b>12 Declarations</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                     |     |
| <b>a. Assessor Declaration</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |     |
| This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report. |                     |     |
| Signed:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Assessor ID:        |     |
| Name:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Date:               |     |
| <b>b. Client Declaration</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                     |     |
| N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |     |

# Summary for Input Data

|                      |                |               |                |            |
|----------------------|----------------|---------------|----------------|------------|
| Property Reference   | SAP VG 21-0282 |               | Issued on Date | 15/11/2024 |
| Assessment Reference | Plot 54        | Prop Type Ref | SAP VG 21-0282 |            |
| Property             |                |               |                |            |

|                                    |          |               |       |      |       |
|------------------------------------|----------|---------------|-------|------|-------|
| SAP Rating                         | 93 A     | DER           | 12.81 | TER  | 12.86 |
| Environmental                      | 88 B     | % DER < TER   |       |      | 0.39  |
| CO <sub>2</sub> Emissions (t/year) | 1.3      | DFEE          | 41.49 | TFEE | 44.09 |
| Compliance Check                   | See BREL | % DFEE < TFEE |       |      | 5.89  |
| % DPER < TPER                      | 0.23     | DPER          | 67.36 | TPER | 67.52 |

|                  |                        |             |           |
|------------------|------------------------|-------------|-----------|
| Assessor Details | Miss Victoria Gartside | Assessor ID | AL30-0001 |
| Client           |                        |             |           |

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

|                                |                            |
|--------------------------------|----------------------------|
| Orientation                    | West                       |
| Property Tenure                | ND                         |
| Transaction Type               | 6                          |
| Terrain Type                   | Suburban                   |
| 1.0 Property Type              | House, Semi-Detached       |
| Which Floor                    | 0                          |
| 2.0 Number of Storeys          | 3                          |
| 3.0 Date Built                 | 2024                       |
| 3.0 Property Age Band          | L                          |
| 4.0 Sheltered Sides            | 1                          |
| 5.0 Sunlight/Shade             | Average or unknown         |
| 6.0 Thermal Mass Parameter     | Precise calculation        |
| Thermal Mass                   | 287.87 kJ/m <sup>2</sup> K |
| 7.0 Electricity Tariff         | Standard                   |
| Smart electricity meter fitted | Yes                        |
| Smart gas meter fitted         | Yes                        |

| 7.0 Measurements | Heat Loss Perimeter | Internal Floor Area  | Unheated Space Floor Area | Average Storey Height |
|------------------|---------------------|----------------------|---------------------------|-----------------------|
| Ground floor:    | 17.45 m             | 25.41 m <sup>2</sup> | 14.76 m <sup>2</sup>      | 2.84 m                |
| 1st Storey:      | 17.93 m             | 40.18 m <sup>2</sup> |                           | 2.39 m                |
| 2nd Storey:      | 17.93 m             | 40.18 m <sup>2</sup> |                           | 2.60 m                |

|                 |                      |
|-----------------|----------------------|
| 8.0 Living Area | 17.74 m <sup>2</sup> |
|-----------------|----------------------|

| 9.0 External Walls | Description    | Type        | Construction                                                                                                    | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Gross Area(m <sup>2</sup> ) | Nett Area (m <sup>2</sup> ) | Shelter Res | Shelter                | Openings | Area Calculation Type |
|--------------------|----------------|-------------|-----------------------------------------------------------------------------------------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------|------------------------|----------|-----------------------|
|                    | Brick wall     | Cavity Wall | Cavity wall; plasterboard on dabs or battens, lightweight aggregate block, filled cavity, any outside structure | 0.19                         | 110.00                      | 125.88                      | 108.11                      | 0.00        | None                   | 17.77    | Enter Gross Area      |
|                    | Retaining wall | Cavity Wall | Cavity wall; plasterboard on dabs or battens, lightweight aggregate block, filled cavity, any outside structure | 0.18                         | 110.00                      | 12.92                       | 12.92                       | 0.00        | None                   | 0.00     | Enter Gross Area      |
|                    | Garage wall    | Cavity Wall | Cavity wall; plasterboard on dabs or battens, lightweight aggregate block, filled cavity, any outside structure | 0.15                         | 110.00                      | 21.32                       | 21.32                       | 0.55        | Garage Single 2 Inside | 0.00     | Enter Gross Area      |

| 9.1 Party Walls | Description  | Type                            | Construction                                                                  | U-Value (W/m <sup>2</sup> K) | Kappa (kJ/m <sup>2</sup> K) | Area (m <sup>2</sup> ) | Shelter Res | Shelter |
|-----------------|--------------|---------------------------------|-------------------------------------------------------------------------------|------------------------------|-----------------------------|------------------------|-------------|---------|
|                 | Party Wall 1 | Filled Cavity with Edge Sealing | Dense plaster both sides. lightweight aggregate blocks, cavity or cavity fill | 0.00                         | 140.00                      | 69.14                  | 0.00        | None    |

| 9.2 Internal Walls | Description   | Construction                      | Kappa (kJ/m <sup>2</sup> K) | Area (m <sup>2</sup> ) |
|--------------------|---------------|-----------------------------------|-----------------------------|------------------------|
|                    | Internal Wall | Dense block, plasterboard on dabs | 75.00                       | 18.20                  |
|                    | Internal Wall | Plasterboard on timber frame      | 9.00                        | 146.34                 |

| 10.0 External Roofs |  |
|---------------------|--|
|---------------------|--|

# Summary for Input Data



| Description | Type                | Construction                             | U-Value<br>(W/m²K) | Kappa<br>(kJ/m²K) | Gross<br>Area(m²) | Nett<br>Area<br>(m²) | Shelter<br>Code | Shelter<br>Factor | Calculation<br>Type | Openings |
|-------------|---------------------|------------------------------------------|--------------------|-------------------|-------------------|----------------------|-----------------|-------------------|---------------------|----------|
| Plane roof  | External Plane Roof | Plasterboard, insulated at ceiling level | 0.09               | 9.00              | 40.18             | 40.18                | None            | 0.00              | Enter Gross Area    | 0.00     |

## 10.2 Internal Ceilings

| Description        | Storey          | Construction                                   | Area (m²) |
|--------------------|-----------------|------------------------------------------------|-----------|
| Internal Ceiling 1 | Lowest occupied | Plasterboard ceiling, carpeted chipboard floor | 65.59     |

## 11.0 Heat Loss Floors

| Description   | Type                   | Storey Index    | Construction                                    | U-Value<br>(W/m²K) | Shelter Code | Shelter Factor | Kappa<br>(kJ/m²K) | Area (m²) |
|---------------|------------------------|-----------------|-------------------------------------------------|--------------------|--------------|----------------|-------------------|-----------|
| Ground floor  | Ground Floor - Solid   | Lowest occupied | Other                                           | 0.13               | None         | 0.00           | 0.00              | 25.41     |
| Exposed floor | Exposed Floor - Timber | Lowest occupied | Timber exposed floor, insulation between joists | 0.20               | None         | 0.00           | 20.00             | 14.76     |

## 11.2 Internal Floors

| Description      | Storey Index | Construction                                   | Kappa<br>(kJ/m²K) | Area (m²) |
|------------------|--------------|------------------------------------------------|-------------------|-----------|
| Internal Floor 1 |              | Plasterboard ceiling, carpeted chipboard floor | 9.00              | 65.59     |

## 12.0 Opening Types

| Description      | Data Source  | Type       | Glazing                | Glazing Gap | Filling Type | G-value | Frame Type | Frame Factor | U Value<br>(W/m²K) |
|------------------|--------------|------------|------------------------|-------------|--------------|---------|------------|--------------|--------------------|
| Solid front door | Manufacturer | Solid Door |                        |             |              | 0.00    |            |              | 1.10               |
| Windows          | Manufacturer | Window     | Double Low-E Soft 0.05 |             |              | 0.73    |            | 0.70         | 1.30               |

## 13.0 Openings

| Name                | Opening Type     | Location   | Orientation | Area (m²) | Pitch |
|---------------------|------------------|------------|-------------|-----------|-------|
| Front door          | Solid front door | Brick wall | West        | 2.14      | 0     |
| Front windows brick | Windows          | Brick wall | West        | 7.00      | 0     |
| Side windows brick  | Windows          | Brick wall | North       | 1.42      | 0     |
| Rear windows brick  | Windows          | Brick wall | East        | 7.21      | 0     |

## 14.0 Conservatory

## 15.0 Draught Proofing

 %

## 16.0 Draught Lobby

## 17.0 Thermal Bridging

## 17.1 List of Bridges

| Bridge Type                                                      | Source Type            | Length | Psi   | Adjusted Reference:           | Imported |
|------------------------------------------------------------------|------------------------|--------|-------|-------------------------------|----------|
| E2 Other lintels (including other steel lintels)                 | Independently assessed | 12.33  | 0.02  | 0.02 MFF-150-E2-02            | No       |
| E3 Sill                                                          | Independently assessed | 9.50   | 0.02  | 0.02 MFF-150-E3-01            | No       |
| E4 Jamb                                                          | Independently assessed | 30.30  | 0.02  | 0.02 MFF-150-E4-01            | No       |
| E5 Ground floor (normal)                                         | Independently assessed | 20.19  | 0.09  | 0.09 Manufacturer Declaration | No       |
| E6 Intermediate floor within a dwelling                          | Independently assessed | 27.87  | 0.00  | 0.00 MFF-150-E6-01            | No       |
| E10 Eaves (insulation at ceiling level)                          | Independently assessed | 9.10   | 0.06  | 0.06 MFF-150-E10-01           | No       |
| E12 Gable (insulation at ceiling level)                          | Independently assessed | 8.85   | 0.06  | 0.06 MFF-150-E12-01           | No       |
| E16 Corner (normal)                                              | Independently assessed | 18.50  | 0.05  | 0.05 MFF-150-E16-01           | No       |
| E17 Corner (inverted – internal area greater than external area) | Independently assessed | 5.68   | -0.09 | -0.09 MFF-150-E17-01          | No       |
| E20 Exposed floor (normal)                                       | Independently assessed | 7.99   | 0.07  | 0.07 MFF-150-E20-01           | No       |
| E21 Exposed floor (inverted)                                     | Table K1 - Default     | 7.51   | 0.32  | 0.32                          | No       |
| E18 Party wall between dwellings                                 | Independently assessed | 15.66  | 0.04  | 0.04 MFF-150-E18-04           | No       |
| P1 Party wall - Ground floor                                     | Independently assessed | 8.83   | 0.07  | 0.07 Manufacturer Declaration | No       |
| P2 Party wall - Intermediate floor within a dwelling             | Table K1 - Default     | 8.83   | 0.00  | 0.00                          | No       |
| P4 Party wall - Roof (insulation at ceiling level)               | Table K1 - Default     | 8.83   | 0.48  | 0.48                          | No       |

Y-value  W/m²K

## 19.0 Mechanical Ventilation

### Mechanical Ventilation

Mechanical Ventilation System Present

## 20.0 Fans, Open Fireplaces, Flues

Number of open chimneys

Number of open flues

Number of chimneys/flues attached to closed fire

Number of flues attached to solid fuel boiler

Number of flues attached to other heater

Number of blocked chimneys

Number of intermittent extract fans

Number of passive vents

Number of flueless gas fires

# Summary for Input Data

|                                                  |                                                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
|--------------------------------------------------|-------------------------------------------------------|--------------------------|-----------------------|---------------------------|---------------------------------------------|-------------|-------------------------|-------------------|--------------------|------------------------|
| <b>21.0 Fixed Cooling System</b>                 | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| <b>22.0 Pressure Testing</b>                     | <input type="text" value="Yes"/>                      |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Designed AP <sub>50</sub>                        | <input type="text" value="4.00"/>                     |                          |                       |                           | m <sup>2</sup> /(h.m <sup>2</sup> ) @ 50 Pa |             |                         |                   |                    |                        |
| Property Tested?                                 | <input type="text" value="Yes"/>                      |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Test Method                                      | <input type="text" value="Blower Door"/>              |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| <b>22.0 Lighting</b>                             | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| No Fixed Lighting                                | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
|                                                  | <b>Name</b><br>Lighting 1                             | <b>Efficacy</b><br>85.00 | <b>Power</b><br>10.00 | <b>Capacity</b><br>850.00 | <b>Count</b><br>25                          |             |                         |                   |                    |                        |
| <b>24.0 Main Heating 1</b>                       | <input type="text" value="Database"/>                 |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Percentage of Heat                               | <input type="text" value="100.00"/>                   |                          |                       |                           | %                                           |             |                         |                   |                    |                        |
| Database Ref. No.                                | <input type="text" value="18120"/>                    |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Fuel Type                                        | <input type="text" value="Mains gas"/>                |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| SAP Code                                         | <input type="text" value="0"/>                        |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| In Winter                                        | <input type="text" value="88.60"/>                    |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| In Summer                                        | <input type="text" value="79.60"/>                    |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Model Name                                       | <input type="text" value="ecoTEC sustain 34"/>        |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Manufacturer                                     | <input type="text" value="Vaillant"/>                 |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| System Type                                      | <input type="text" value="Combi boiler"/>             |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Controls SAP Code                                | <input type="text" value="2110"/>                     |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Delayed Start Stat                               | <input type="text" value="Yes"/>                      |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Burner Control                                   | <input type="text" value="Modulating"/>               |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| HETAS approved System                            | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Flue Type                                        | <input type="text" value="Balanced"/>                 |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Fan Assisted Flue                                | <input type="text" value="Yes"/>                      |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Is MHS Pumped                                    | <input type="text" value="Pump in heated space"/>     |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Heating Pump Age                                 | <input type="text" value="2013 or later"/>            |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Heat Emitter                                     | <input type="text" value="Radiators and Underfloor"/> |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Underfloor Heating                               | <input type="text" value="Yes - Pipes in Concrete"/>  |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Flow Temperature                                 | <input type="text" value="Unknown"/>                  |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Boiler Interlock                                 | <input type="text" value="Yes"/>                      |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Combi boiler type                                | <input type="text" value="Standard Combi"/>           |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| <b>25.0 Main Heating 2</b>                       | <input type="text" value="None"/>                     |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| <b>26.0 Heat Networks</b>                        | <input type="text" value="None"/>                     |                          |                       |                           |                                             |             |                         |                   |                    |                        |
|                                                  | <b>Heat Source</b>                                    | <b>Fuel Type</b>         | <b>Heating Use</b>    | <b>Efficiency</b>         | <b>Percentage Of Heat</b>                   | <b>Heat</b> | <b>Heat Power Ratio</b> | <b>Electrical</b> | <b>Fuel Factor</b> | <b>Efficiency type</b> |
| Heat source 1                                    | None                                                  |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Heat source 2                                    | None                                                  |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Heat source 3                                    | None                                                  |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Heat source 4                                    | None                                                  |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Heat source 5                                    | None                                                  |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| <b>27.0 Secondary Heating</b>                    | <input type="text" value="None"/>                     |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| <b>28.0 Water Heating</b>                        | <input type="text" value="Main Heating 1"/>           |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Water Heating                                    | <input type="text" value="Main Heating 1"/>           |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| SAP Code                                         | <input type="text" value="901"/>                      |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Flue Gas Heat Recovery System                    | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Waste Water Heat Recovery Instantaneous System 1 | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Waste Water Heat Recovery Instantaneous System 2 | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |
| Waste Water Heat Recovery Storage System         | <input type="text" value="No"/>                       |                          |                       |                           |                                             |             |                         |                   |                    |                        |

# Summary for Input Data

|                                    |            |
|------------------------------------|------------|
| Solar Panel                        | No         |
| Water use <= 125 litres/person/day | Yes        |
| Summer Immersion                   | No         |
| Cold Water Source                  | From mains |
| Bath Count                         | 1          |
| Supplementary Immersion            | No         |
| Immersion Only Heating Hot Water   | No         |

## 28.1 Showers

| Description | Shower Type                               | Flow Rate [l/min] | Rated Power [kW] | Connected | Connected To |
|-------------|-------------------------------------------|-------------------|------------------|-----------|--------------|
| Shower      | Combi boiler or unvented hot water system | 8.00              |                  | No        |              |
| Shower      | Combi boiler or unvented hot water system | 8.00              |                  | No        |              |

## 28.3 Waste Water Heat Recovery System

## 29.0 Hot Water Cylinder

|                          |      |
|--------------------------|------|
|                          | None |
| Cylinder Stat            | No   |
| Cylinder In Heated Space | No   |
| Independent Time Control | No   |
| In Airing Cupboard       | No   |

## 31.0 Thermal Store

|  |      |
|--|------|
|  | None |
|--|------|

## 32.0 Photovoltaic Unit

|                        |              |
|------------------------|--------------|
|                        | One Dwelling |
| Export Capable Meter?  | Yes          |
| Connected To Dwelling  | Yes          |
| Diverter               | No           |
| Battery Capacity [kWh] | 0.00         |

| PV Cells kWp | Orientation | Elevation | Overshading    | FGHRS | MCS Certificate | Overshading Factor | MCS Certificate Reference | Panel Manufacturer |
|--------------|-------------|-----------|----------------|-------|-----------------|--------------------|---------------------------|--------------------|
| 2.43         | East        | 30°       | None Or Little | No    | No              | 1.00               |                           | PV                 |
| 0.60         | West        | 30°       | None Or Little | No    | No              | 1.00               |                           | Front panels       |

## 34.0 Small-scale Hydro

|                                           |        |          |
|-------------------------------------------|--------|----------|
|                                           | None   |          |
| Electricity Generated                     | 0.00   |          |
| Apportioned                               | 0.00   | kWh/Year |
| Connected to dwelling's electricity meter | Yes    |          |
| Electricity Generation                    | Annual |          |

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

## Recommendations

### Lower cost measures

None

### Further measures to achieve even higher standards

None

# Full SAP Calculation Printout



|                                    |                        |               |                |      |                |            |
|------------------------------------|------------------------|---------------|----------------|------|----------------|------------|
| Property Reference                 | SAP VG 21-0282         |               |                |      | Issued on Date | 15/11/2024 |
| Assessment Reference               | Plot 54                | Prop Type Ref | SAP VG 21-0282 |      |                |            |
| Property                           |                        |               |                |      |                |            |
|                                    |                        |               |                |      |                |            |
| SAP Rating                         | 93 A                   | DER           | 12.81          | TER  | 12.86          |            |
| Environmental                      | 88 B                   | % DER < TER   |                |      |                | 0.39       |
| CO <sub>2</sub> Emissions (t/year) | 1.3                    | DFEE          | 41.49          | TFEE | 44.09          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |                |      |                | 5.89       |
| % DPER < TPER                      | 0.23                   | DPER          | 67.36          | TPER | 67.52          |            |
|                                    |                        |               |                |      |                |            |
| Assessor Details                   | Miss Victoria Gartside |               |                |      | Assessor ID    | AL30-0001  |
| Client                             |                        |               |                |      |                |            |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 25.4100 (1b)              | x 2.8400 (2b)                     | = 72.1644 (1b) - (3b)       |
| First floor                                            | 40.1800 (1c)              | x 2.3900 (2c)                     | = 96.0302 (1c) - (3c)       |
| Second floor                                           | 40.1800 (1d)              | x 2.6000 (2d)                     | = 104.4680 (1d) - (3d)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700                  |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 272.6626 (5)                |

## 2. Ventilation rate

|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of open chimneys                                                                            | 0 * 80 = 0.0000 (6a)                    |
| Number of open flues                                                                               | 0 * 20 = 0.0000 (6b)                    |
| Number of chimneys / flues attached to closed fire                                                 | 0 * 10 = 0.0000 (6c)                    |
| Number of flues attached to solid fuel boiler                                                      | 0 * 20 = 0.0000 (6d)                    |
| Number of flues attached to other heater                                                           | 0 * 35 = 0.0000 (6e)                    |
| Number of blocked chimneys                                                                         | 0 * 20 = 0.0000 (6f)                    |
| Number of intermittent extract fans                                                                | 6 * 10 = 60.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 60.0000 / (5) = 0.2201 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 4.0000 (17)                             |
| Infiltration rate                                                                                  | 0.4201 (18)                             |
| Number of sides sheltered                                                                          | 1 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3885 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4954 | 0.4857 | 0.4760 | 0.4274 | 0.4177 | 0.3691 | 0.3691 | 0.3594 | 0.3885 | 0.4177 | 0.4371 | 0.4565 (22b) |
| Effective ac    | 0.6227 | 0.6179 | 0.6133 | 0.5913 | 0.5872 | 0.5681 | 0.5681 | 0.5646 | 0.5755 | 0.5872 | 0.5955 | 0.6042 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K    |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|------------------|
| Solid front door                                               |                         |                            | 2.1400                    | 1.1000                        | 2.3540       |                                      | (26)             |
| Windows (Uw = 1.30)                                            |                         |                            | 15.6300                   | 1.2357                        | 19.3146      |                                      | (27)             |
| Ground floor                                                   |                         |                            | 25.4100                   | 0.1300                        | 3.3033       | 0.0000                               | 0.0000 (28a)     |
| Exposed floor                                                  |                         |                            | 14.7600                   | 0.2000                        | 2.9520       | 20.0000                              | 295.2000 (28b)   |
| Brick wall                                                     | 125.8800                | 17.7700                    | 108.1100                  | 0.1900                        | 20.5409      | 110.0000                             | 11892.1000 (29a) |
| Retaining wall                                                 | 12.9200                 |                            | 12.9200                   | 0.1800                        | 2.3256       | 110.0000                             | 1421.2000 (29a)  |
| Garage wall                                                    | 21.3200                 |                            | 21.3200                   | 0.1400                        | 2.9848       | 110.0000                             | 2345.2000 (29a)  |
| Plane roof                                                     | 40.1800                 |                            | 40.1800                   | 0.0900                        | 3.6162       | 9.0000                               | 361.6200 (30)    |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 240.4700                  |                               |              |                                      | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 57.3914      |                                      | (33)             |
| Party Wall 1                                                   |                         |                            | 69.1400                   | 0.0000                        | 0.0000       | 140.0000                             | 9679.6000 (32)   |
| Internal Wall                                                  |                         |                            | 18.2000                   |                               |              | 75.0000                              | 1365.0000 (32c)  |
| Internal Wall                                                  |                         |                            | 146.3400                  |                               |              | 9.0000                               | 1317.0600 (32c)  |
| Internal Floor 1                                               |                         |                            | 65.5900                   |                               |              | 18.0000                              | 1180.6200 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 65.5900                   |                               |              | 9.0000                               | 590.3100 (32e)   |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 30447.9100 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 287.8691 (35)    |

# Full SAP Calculation Printout



## List of Thermal Bridges

|                                                                  | Length  | Psi-value             | Total        |
|------------------------------------------------------------------|---------|-----------------------|--------------|
| K1 Element                                                       | 12.3300 | 0.0240                | 0.2959       |
| E2 Other lintels (including other steel lintels)                 | 9.5000  | 0.0220                | 0.2090       |
| E3 Sill                                                          | 30.3000 | 0.0170                | 0.5151       |
| E4 Jamb                                                          | 20.1900 | 0.0920                | 1.8575       |
| E5 Ground floor (normal)                                         | 27.8700 | 0.0010                | 0.0279       |
| E6 Intermediate floor within a dwelling                          | 9.1000  | 0.0600                | 0.5460       |
| E10 Eaves (insulation at ceiling level)                          | 8.8500  | 0.0560                | 0.4956       |
| E12 Gable (insulation at ceiling level)                          | 18.5000 | 0.0460                | 0.8510       |
| E16 Corner (normal)                                              | 5.6800  | -0.0880               | -0.4998      |
| E17 Corner (inverted - internal area greater than external area) | 7.9900  | 0.0690                | 0.5513       |
| E20 Exposed floor (normal)                                       | 7.5100  | 0.3200                | 2.4032       |
| E21 Exposed floor (inverted)                                     | 15.6600 | 0.0380                | 0.5951       |
| E18 Party wall between dwellings                                 | 8.8300  | 0.0690                | 0.6093       |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0000                | 0.0000       |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.4800                | 4.2384       |
| P4 Party wall - Roof (insulation at ceiling level)               |         |                       |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)       |         |                       | 12.6954 (36) |
| Point Thermal bridges                                            |         |                       | 0.0000       |
| Total fabric heat loss                                           |         | (33) + (36) + (36a) = | 70.0868 (37) |

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (38)m                                                               | 56.0306  | 55.6019  | 55.1816  | 53.2077  | 52.8384  | 51.1191  | 51.1191  | 50.8008  | 51.7814  | 52.8384  | 53.5855  | 54.3666 (38)  |
| Heat transfer coeff                                                 | 126.1174 | 125.6887 | 125.2684 | 123.2945 | 122.9252 | 121.2060 | 121.2060 | 120.8876 | 121.8682 | 122.9252 | 123.6723 | 124.4534 (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 123.2927      |
| HLP                                                                 | 1.1924   | 1.1883   | 1.1843   | 1.1657   | 1.1622   | 1.1459   | 1.1459   | 1.1429   | 1.1522   | 1.1622   | 1.1693   | 1.1766 (40)   |
| HLP (average)                                                       |          |          |          |          |          |          |          |          |          |          |          | 1.1657        |
| Days in mont                                                        | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31            |

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

|                                                                                |          |          |          |          |          |          |          |          |          |                                        |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------|----------|----------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |                                        |          | 2.7869 (42)    |
| Hot water usage for mixer showers                                              | 70.9471  | 69.8809  | 68.3272  | 65.3546  | 63.1608  | 60.7144  | 59.3238  | 60.8657  | 62.5559  | 65.1827                                | 68.2192  | 70.6752 (42a)  |
| Hot water usage for baths                                                      | 30.6328  | 30.1778  | 29.5372  | 28.3559  | 27.4714  | 26.4907  | 25.9609  | 26.5971  | 27.2897  | 28.3392                                | 29.5448  | 30.5292 (42b)  |
| Hot water usage for other uses                                                 | 43.1707  | 41.6009  | 40.0310  | 38.4612  | 36.8913  | 35.3215  | 35.3215  | 36.8913  | 38.4612  | 40.0310                                | 41.6009  | 43.1707 (42c)  |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |                                        |          | 133.0583 (43)  |
| Daily hot water use                                                            | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541 | 128.3069 | 133.5529                               | 139.3648 | 144.3752 (44)  |
| Energy conte                                                                   | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764 | 158.2152 | 181.2300                               | 198.5507 | 226.0566 (45)  |
| Energy content (annual)                                                        |          |          |          |          |          |          |          |          |          | Total = Sum(45)m =                     |          | 2210.0711      |
| Distribution loss (46)m = 0.15 x (45)m                                         | 34.3874  | 30.2582  | 31.7910  | 27.1405  | 25.7507  | 22.5991  | 21.8794  | 23.0965  | 23.7323  | 27.1845                                | 29.7826  | 33.9085 (46)   |
| Water storage loss:                                                            |          |          |          |          |          |          |          |          |          |                                        |          |                |
| Total storage loss                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                                   |          |          |          |          |          |          |          |          |          |                                        |          |                |
| Primary loss                                                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (57)    |
| Combi loss                                                                     | 2.5528   | 2.3647   | 2.6361   | 2.4472   | 2.4735   | 2.3138   | 2.2934   | 2.3113   | 2.2561   | 2.4036                                 | 2.4141   | 2.5334 (61)    |
| Total heat required for water heating calculated for each month                | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337                               | 200.9648 | 228.5900 (62)  |
| WWHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (63a)   |
| PV diverter                                                                    | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000                                | -0.0000  | -0.0000 (63b)  |
| Solar input                                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (63c)   |
| FGHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (63d)   |
| Output from w/h                                                                | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337                               | 200.9648 | 228.5900 (64)  |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m = |          | 2239.0711 (64) |
| Electric shower(s)                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (64a)   |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |                                        |          | 0.0000 (64a)   |
| Heat gains from water heating, kWh/month                                       | 76.8636  | 67.6635  | 71.1291  | 60.7732  | 57.6991  | 50.6731  | 49.0727  | 51.7750  | 53.1706  | 60.8599                                | 66.6216  | 75.7972 (65)   |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 141.9174  | 157.1228  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.3326  | 268.0859  | 261.1477  | 246.3769  | 227.7314  | 210.2073  | 198.5001  | 195.7468  | 202.6851  | 217.4559  | 236.1013  | 253.6254 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 (71) |
| Water heating gains (Table 5)                                                       | 103.3114  | 100.6898  | 95.6036   | 84.4072   | 77.5525   | 70.3794   | 65.9580   | 69.5900   | 73.8480   | 81.8009   | 92.5301   | 101.8779 (72)  |
| Total internal gains                                                                | 578.3650  | 593.7021  | 566.4723  | 545.2356  | 515.0049  | 492.0382  | 471.1791  | 472.0578  | 487.9847  | 508.9778  | 543.0830  | 565.2243 (73)  |

## 6. Solar gains

| [Jan] | Area<br>m <sup>2</sup> | Solar flux<br>Table 6a<br>W/m <sup>2</sup> | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-------|------------------------|--------------------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| North | 1.4200                 | 10.6334                                    | 0.7300                            | 0.7000                             | 0.7700                       | 5.3471 (74)  |
| East  | 7.2100                 | 19.6403                                    | 0.7300                            | 0.7000                             | 0.7700                       | 50.1460 (76) |

# Full SAP Calculation Printout



|                                                                                                      |           |           |           |           |           |           |           |           |           |                           |              |                 |
|------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------------------|--------------|-----------------|
| West                                                                                                 | 7.0000    |           | 19.6403   |           | 0.7300    |           | 0.7000    |           | 0.7700    |                           | 48.6855 (80) |                 |
| Solar gains                                                                                          | 104.1786  | 203.5539  | 335.7596  | 492.2521  | 606.6636  | 622.7884  | 592.1794  | 506.2095  | 391.1845  | 241.5726                  | 129.8276     | 85.7318 (83)    |
| Total gains                                                                                          | 682.5436  | 797.2561  | 902.2319  | 1037.4877 | 1121.6685 | 1114.8266 | 1063.3584 | 978.2673  | 879.1691  | 750.5504                  | 672.9105     | 650.9561 (84)   |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| 7. Mean internal temperature (heating season)                                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Temperature during heating periods in the living area from Table 9, Th1 (C)                          |           |           |           |           |           |           |           |           |           |                           |              | 21.0000 (85)    |
| Utilisation factor for gains for living area, nil,m (see Table 9a)                                   |           |           |           |           |           |           |           |           |           |                           |              |                 |
|                                                                                                      | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct                       | Nov          | Dec             |
| tau                                                                                                  | 67.0625   | 67.2913   | 67.5170   | 68.5980   | 68.8041   | 69.7800   | 69.7800   | 69.9638   | 69.4008   | 68.8041                   | 68.3884      | 67.9592         |
| alpha                                                                                                | 5.4708    | 5.4861    | 5.5011    | 5.5732    | 5.5869    | 5.6520    | 5.6520    | 5.6643    | 5.6267    | 5.5869                    | 5.5592       | 5.5306          |
| util living area                                                                                     | 0.9986    | 0.9963    | 0.9892    | 0.9557    | 0.8561    | 0.6659    | 0.4964    | 0.5582    | 0.8296    | 0.9783                    | 0.9967       | 0.9989 (86)     |
| MIT                                                                                                  | 20.5098   | 20.5540   | 20.6230   | 20.7201   | 20.7921   | 20.8278   | 20.8341   | 20.8334   | 20.8094   | 20.7105                   | 20.5961      | 20.5072 (87)    |
| Th 2                                                                                                 | 19.9261   | 19.9294   | 19.9325   | 19.9476   | 19.9504   | 19.9635   | 19.9635   | 19.9659   | 19.9584   | 19.9504                   | 19.9447      | 19.9387 (88)    |
| util rest of house                                                                                   | 0.9980    | 0.9949    | 0.9847    | 0.9372    | 0.8024    | 0.5713    | 0.3823    | 0.4383    | 0.7489    | 0.9659                    | 0.9951       | 0.9985 (89)     |
| MIT 2                                                                                                | 19.3360   | 19.3955   | 19.4862   | 19.6204   | 19.7036   | 19.7484   | 19.7519   | 19.7544   | 19.7301   | 19.6136                   | 19.4639      | 19.3445 (90)    |
| Living area fraction                                                                                 | 19.5329   | 19.5898   | 19.6769   | 19.8049   | 19.8861   | 19.9294   | 19.9334   | 19.9354   | 19.9111   | fLA = Living area / (4) = | 19.6538      | 0.1677 (91)     |
| MIT                                                                                                  | 19.5329   | 19.5898   | 19.6769   | 19.8049   | 19.8861   | 19.9294   | 19.9334   | 19.9354   | 19.9111   | 19.7976                   | 19.6538      | 19.5395 (92)    |
| Temperature adjustment                                                                               | 19.3829   | 19.4398   | 19.5269   | 19.6549   | 19.7361   | 19.7794   | 19.7834   | 19.7854   | 19.7611   | 19.6476                   | 19.5038      | -0.1500         |
| adjusted MIT                                                                                         | 19.3829   | 19.4398   | 19.5269   | 19.6549   | 19.7361   | 19.7794   | 19.7834   | 19.7854   | 19.7611   | 19.6476                   | 19.5038      | 19.3895 (93)    |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| 8. Space heating requirement                                                                         |           |           |           |           |           |           |           |           |           |                           |              |                 |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
|                                                                                                      | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct                       | Nov          | Dec             |
| Utilisation                                                                                          | 0.9976    | 0.9940    | 0.9825    | 0.9308    | 0.7896    | 0.5533    | 0.3621    | 0.4166    | 0.7307    | 0.9609                    | 0.9942       | 0.9982 (94)     |
| Useful gains                                                                                         | 680.9349  | 792.4887  | 886.4099  | 965.6680  | 885.6172  | 616.8553  | 385.0460  | 407.5355  | 642.4142  | 721.2347                  | 669.0232     | 649.7813 (95)   |
| Ext temp.                                                                                            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000   | 16.6000   | 16.4000   | 14.1000   | 10.6000                   | 7.1000       | 4.2000 (96)     |
| Heat loss rate W                                                                                     | 1902.2173 | 1827.4927 | 1631.8533 | 1326.0167 | 987.8438  | 627.7740  | 385.8454  | 409.2504  | 689.9064  | 1112.1793                 | 1534.0087    | 1890.3849 (97)  |
| Space heating kWh                                                                                    | 908.6341  | 695.5227  | 554.6099  | 259.4510  | 76.0566   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 290.8628                  | 622.7895     | 923.0091 (98a)  |
| Space heating requirement - total per year (kWh/year)                                                |           |           |           |           |           |           |           |           |           |                           |              | 4330.9357       |
| Solar heating kWh                                                                                    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (98b)    |
| Solar heating contribution - total per year (kWh/year)                                               |           |           |           |           |           |           |           |           |           |                           |              | 0.0000          |
| Space heating kWh                                                                                    | 908.6341  | 695.5227  | 554.6099  | 259.4510  | 76.0566   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 290.8628                  | 622.7895     | 923.0091 (98c)  |
| Space heating requirement after solar contribution - total per year (kWh/year)                       |           |           |           |           |           |           |           |           |           |                           |              | 4330.9357       |
| Space heating per m2                                                                                 |           |           |           |           |           |           |           |           |           | (98c) / (4) =             |              | 40.9467 (99)    |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| 9a. Energy requirements - Individual heating systems, including micro-CHP                            |           |           |           |           |           |           |           |           |           |                           |              |                 |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Fraction of space heat from secondary/supplementary system (Table 11)                                |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (201)    |
| Fraction of space heat from main system(s)                                                           |           |           |           |           |           |           |           |           |           |                           |              | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                                                     |           |           |           |           |           |           |           |           |           |                           |              | 88.6000 (206)   |
| Efficiency of main space heating system 2 (in %)                                                     |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %                                              |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (208)    |
|                                                                                                      | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct                       | Nov          | Dec             |
| Space heating requirement                                                                            | 908.6341  | 695.5227  | 554.6099  | 259.4510  | 76.0566   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 290.8628                  | 622.7895     | 923.0091 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 88.6000   | 88.6000   | 88.6000   | 88.6000   | 88.6000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 88.6000                   | 88.6000      | 88.6000 (210)   |
| Space heating fuel (main heating system)                                                             | 1025.5464 | 785.0143  | 625.9706  | 292.8341  | 85.8426   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 328.2875                  | 702.9227     | 1041.7710 (211) |
| Space heating efficiency (main heating system 2)                                                     | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (212)    |
| Space heating fuel (main heating system 2)                                                           | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (213)    |
| Space heating fuel (secondary)                                                                       | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (215)    |
| Water heating                                                                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Water heating requirement                                                                            | 231.8023  | 204.0860  | 214.5762  | 183.3837  | 174.1448  | 152.9745  | 148.1562  | 156.2877  | 160.4713  | 183.6337                  | 200.9648     | 228.5900 (64)   |
| Efficiency of water heater (217)m                                                                    | 86.6096   | 86.3842   | 85.8909   | 84.6371   | 82.1362   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 84.8856                   | 86.2217      | 79.6000 (216)   |
| Fuel for water heating, kWh/month                                                                    | 267.6404  | 236.2538  | 249.8242  | 216.6705  | 212.0194  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 216.3306                  | 233.0792     | 86.6552 (217)   |
| Space cooling fuel requirement                                                                       |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (221)m                                                                                               | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (221)    |
| Pumps and Fa                                                                                         | 7.3041    | 6.5973    | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041                    | 7.0685       | 7.3041 (231)    |
| Lighting                                                                                             | 28.8849   | 23.1726   | 20.8643   | 15.2861   | 11.8074   | 9.6468    | 10.7711   | 14.0007   | 18.1855   | 23.8604                   | 26.9503      | 29.6877 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (233a)m                                                                                              | -33.0601  | -51.3704  | -81.6378  | -98.5308  | -109.6129 | -103.2046 | -101.4318 | -93.7910  | -79.9001  | -61.4567                  | -37.5969     | -27.7837 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (234a)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (234a)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235a)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235a)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235c)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235c)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (233b)m                                                                                              | -14.9249  | -36.2530  | -85.9866  | -150.0681 | -216.2967 | -224.4244 | -218.8576 | -173.8982 | -112.6673 | -55.7180                  | -20.8495     | -11.3176 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (234b)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235b)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235b)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235d)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235d)   |
| Annual totals kWh/year                                                                               |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Space heating fuel - main system 1                                                                   |           |           |           |           |           |           |           |           |           |                           |              | 4888.1893 (211) |
| Space heating fuel - main system 2                                                                   |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (215)    |
| Efficiency of water heater                                                                           |           |           |           |           |           |           |           |           |           |                           |              | 79.6000         |
| Water heating fuel used                                                                              |           |           |           |           |           |           |           |           |           |                           |              | 2671.8541 (219) |
| Space cooling fuel                                                                                   |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (221)    |

# Full SAP Calculation Printout



|                                                               |                  |
|---------------------------------------------------------------|------------------|
| Electricity for pumps and fans:                               |                  |
| central heating pump                                          | 41.0000 (230c)   |
| main heating flue fan                                         | 45.0000 (230e)   |
| Total electricity for the above, kWh/year                     | 86.0000 (231)    |
| Electricity for lighting (calculated in Appendix L)           | 233.1179 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q) |                  |
| PV generation                                                 | -2200.6387 (233) |
| Wind generation                                               | 0.0000 (234)     |
| Hydro-electric generation (Appendix N)                        | 0.0000 (235a)    |
| Electricity generated - Micro CHP (Appendix N)                | 0.0000 (235)     |
| Appendix Q - special features                                 |                  |
| Energy saved or generated                                     | -0.0000 (236)    |
| Energy used                                                   | 0.0000 (237)     |
| Total delivered energy for all uses                           | 5678.5225 (238)  |

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

|                                                 | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                   | 4888.1893          | 0.2100                        | 1026.5197 (261)          |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                      | 2671.8541          | 0.2100                        | 561.0894 (264)           |
| Space and water heating                         |                    |                               | 1587.6091 (265)          |
| Pumps, fans and electric keep-hot               | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                             | 233.1179           | 0.1443                        | 33.6461 (268)            |
| Energy saving/generation technologies           |                    |                               |                          |
| PV Unit electricity used in dwelling            | -879.3767          | 0.1332                        | -117.1173                |
| PV Unit electricity exported                    | -1321.2619         | 0.1223                        | -161.6557                |
| Total                                           |                    |                               | -278.7731 (269)          |
| Total CO2, kg/year                              |                    |                               | 1354.4114 (272)          |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 12.8100 (273)            |

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

|                                             | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1               | 4888.1893          | 1.1300                              | 5523.6539 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2671.8541          | 1.1300                              | 3019.1951 (278)            |
| Space and water heating                     |                    |                                     | 8542.8489 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 233.1179           | 1.5338                              | 357.5639 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -879.3767          | 1.4921                              | -1312.1603                 |
| PV Unit electricity exported                | -1321.2619         | 0.4489                              | -593.1622                  |
| Total                                       |                    |                                     | -1905.3225 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 7125.1912 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 67.3600 (287)              |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF TARGET EMISSIONS

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 25.4100 (1b)              | x 2.8400 (2b)                     | = 72.1644 (1b) - (3b)       |
| First floor                                            | 40.1800 (1c)              | x 2.3900 (2c)                     | = 96.0302 (1c) - (3c)       |
| Second floor                                           | 40.1800 (1d)              | x 2.6000 (2d)                     | = 104.4680 (1d) - (3d)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700                  |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 272.6626 (5)                |

## 2. Ventilation rate

|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of open chimneys                                                                            | 0 * 80 = 0.0000 (6a)                    |
| Number of open flues                                                                               | 0 * 20 = 0.0000 (6b)                    |
| Number of chimneys / flues attached to closed fire                                                 | 0 * 10 = 0.0000 (6c)                    |
| Number of flues attached to solid fuel boiler                                                      | 0 * 20 = 0.0000 (6d)                    |
| Number of flues attached to other heater                                                           | 0 * 35 = 0.0000 (6e)                    |
| Number of blocked chimneys                                                                         | 0 * 20 = 0.0000 (6f)                    |
| Number of intermittent extract fans                                                                | 4 * 10 = 40.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) = 0.1467 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0000 (17)                             |
| Infiltration rate                                                                                  | 0.3967 (18)                             |
| Number of sides sheltered                                                                          | 1 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3669 (21)        |

# Full SAP Calculation Printout



|                 |               |               |               |               |               |               |               |               |               |               |               |                    |
|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------------|
| Wind speed      | Jan<br>5.1000 | Feb<br>5.0000 | Mar<br>4.9000 | Apr<br>4.4000 | May<br>4.3000 | Jun<br>3.8000 | Jul<br>3.8000 | Aug<br>3.7000 | Sep<br>4.0000 | Oct<br>4.3000 | Nov<br>4.5000 | Dec<br>4.7000 (22) |
| Wind factor     | 1.2750        | 1.2500        | 1.2250        | 1.1000        | 1.0750        | 0.9500        | 0.9500        | 0.9250        | 1.0000        | 1.0750        | 1.1250        | 1.1750 (22a)       |
| Adj infilt rate |               |               |               |               |               |               |               |               |               |               |               |                    |
| Effective ac    | 0.4679        | 0.4587        | 0.4495        | 0.4036        | 0.3945        | 0.3486        | 0.3486        | 0.3394        | 0.3669        | 0.3945        | 0.4128        | 0.4312 (22b)       |
|                 | 0.6094        | 0.6052        | 0.6010        | 0.5815        | 0.5778        | 0.5608        | 0.5608        | 0.5576        | 0.5673        | 0.5778        | 0.5852        | 0.5930 (25)        |

## 3. Heat losses and heat loss parameter

| Element                                        | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |
|------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|-------------------|---------------|
| TER Opaque door                                |             |                | 2.1400        | 1.0000               | 2.1400       |                   | (26)          |
| TER Opening Type (Uw = 1.20)                   |             |                | 15.6300       | 1.1450               | 17.8969      |                   | (27)          |
| Ground floor                                   |             |                | 25.4100       | 0.1300               | 3.3033       |                   | (28a)         |
| Exposed floor                                  |             |                | 14.7600       | 0.1300               | 1.9188       |                   | (28b)         |
| Brick wall                                     | 125.8800    | 17.7700        | 108.1100      | 0.1800               | 19.4598      |                   | (29a)         |
| Retaining wall                                 | 12.9200     |                | 12.9200       | 0.1800               | 2.3256       |                   | (29a)         |
| Garage wall                                    | 21.3200     |                | 21.3200       | 0.1800               | 3.8376       |                   | (29a)         |
| Plane roof                                     | 40.1800     |                | 40.1800       | 0.1100               | 4.4198       |                   | (30)          |
| Total net area of external elements Aum(A, m2) |             |                | 240.4700      |                      |              |                   | (31)          |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               | (26)...(30) + (32) = | 55.3018      |                   | (33)          |
| Party Wall 1                                   |             |                | 69.1400       | 0.0000               | 0.0000       |                   | (32)          |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

287.8691 (35)

List of Thermal Bridges

| K1 Element                                                       | Length  | Psi-value | Total   |
|------------------------------------------------------------------|---------|-----------|---------|
| E2 Other lintels (including other steel lintels)                 | 12.3300 | 0.0500    | 0.6165  |
| E3 Sill                                                          | 9.5000  | 0.0500    | 0.4750  |
| E4 Jamb                                                          | 30.3000 | 0.0500    | 1.5150  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.1600    | 3.2304  |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0000    | 0.0000  |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460  |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0600    | 0.5310  |
| E16 Corner (normal)                                              | 18.5000 | 0.0900    | 1.6650  |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0900   | -0.5112 |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.3200    | 2.5568  |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032  |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0600    | 0.9396  |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0800    | 0.7064  |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000    | 0.0000  |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.1200    | 1.0596  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

15.7333 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 71.0351 (37)

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

|                           |                |                |                |                |                |                |                |                |                |                |                |                     |
|---------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| (38)m                     | Jan<br>54.8372 | Feb<br>54.4548 | Mar<br>54.0799 | Apr<br>52.3194 | May<br>51.9900 | Jun<br>50.4566 | Jul<br>50.4566 | Aug<br>50.1726 | Sep<br>51.0472 | Oct<br>51.9900 | Nov<br>52.6563 | Dec<br>53.3530 (38) |
| Heat transfer coeff       | 125.8723       | 125.4899       | 125.1151       | 123.3545       | 123.0251       | 121.4917       | 121.4917       | 121.2077       | 122.0824       | 123.0251       | 123.6915       | 124.3881 (39)       |
| Average = Sum(39)m / 12 = |                |                |                |                |                |                |                |                |                |                |                | 123.3529            |

|               |               |               |               |               |               |               |               |               |               |               |               |                    |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------------|
| HLP           | Jan<br>1.1901 | Feb<br>1.1864 | Mar<br>1.1829 | Apr<br>1.1663 | May<br>1.1631 | Jun<br>1.1486 | Jul<br>1.1486 | Aug<br>1.1460 | Sep<br>1.1542 | Oct<br>1.1631 | Nov<br>1.1694 | Dec<br>1.1760 (40) |
| HLP (average) |               |               |               |               |               |               |               |               |               |               |               | 1.1662             |
| Days in mont  | 31            | 28            | 31            | 30            | 31            | 30            | 31            | 31            | 30            | 31            | 30            | 31                 |

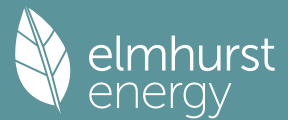
## 4. Water heating energy requirements (kWh/year)

|                                          |         |         |         |         |         |         |         |         |         |         |               |               |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------|---------------|
| Assumed occupancy                        |         |         |         |         |         |         |         |         |         |         |               | 2.7869 (42)   |
| Hot water usage for mixer showers        |         |         |         |         |         |         |         |         |         |         |               |               |
| 70.9471                                  | 69.8809 | 68.3272 | 65.3546 | 63.1608 | 60.7144 | 59.3238 | 60.8657 | 62.5559 | 65.1827 | 68.2192 | 70.6752 (42a) |               |
| Hot water usage for baths                |         |         |         |         |         |         |         |         |         |         |               |               |
| 30.6328                                  | 30.1778 | 29.5372 | 28.3559 | 27.4714 | 26.4907 | 25.9609 | 26.5971 | 27.2897 | 28.3392 | 29.5448 | 30.5292 (42b) |               |
| Hot water usage for other uses           |         |         |         |         |         |         |         |         |         |         |               |               |
| 43.1707                                  | 41.6009 | 40.0310 | 38.4612 | 36.8913 | 35.3215 | 35.3215 | 36.8913 | 38.4612 | 40.0310 | 41.6009 | 43.1707 (42c) |               |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |               | 133.0583 (43) |

|                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug                         | Sep        | Oct      | Nov      | Dec            |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|-----------------------------|------------|----------|----------|----------------|
| Daily hot water use                                             | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541                    | 128.3069   | 133.5529 | 139.3648 | 144.3752 (44)  |
| Energy content (annual)                                         | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764                    | 158.2152   | 181.2300 | 198.5507 | 226.0566 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 34.3874  | 30.2582  | 31.7910  | 27.1405  | 25.7507  | 22.5991  | 21.8794  | 23.0965                     | 23.7323    | 27.1845  | 29.7826  | 33.9085 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |                             |            |          |          |                |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000     | 0.0000   | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000     | 0.0000   | 0.0000   | 0.0000 (57)    |
| Primary loss                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000     | 0.0000   | 0.0000   | 0.0000 (59)    |
| Combi loss                                                      | 50.9589  | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589                     | 49.3151    | 50.9589  | 49.3151  | 50.9589 (61)   |
| Total heat required for water heating calculated for each month | 280.2084 | 247.7487 | 262.8990 | 230.2515 | 222.6302 | 199.9758 | 196.8217 | 204.9353                    | 207.5303   | 232.1889 | 247.8658 | 277.0155 (62)  |
| WWHRS                                                           | -32.4340 | -28.6849 | -30.0372 | -24.8720 | -23.1798 | -19.8351 | -18.5923 | -19.7710                    | -20.5222   | -24.1934 | -27.4082 | -31.8334 (63a) |
| PV diverter                                                     | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000                     | -0.0000    | -0.0000  | -0.0000  | -0.0000 (63b)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000     | 0.0000   | 0.0000   | 0.0000 (63c)   |
| FGHRS                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000     | 0.0000   | 0.0000   | 0.0000 (63d)   |
| Output from w/h                                                 | 247.7744 | 219.0638 | 232.8618 | 205.3795 | 199.4504 | 180.1406 | 178.2294 | 185.1643                    | 187.0081   | 207.9955 | 220.4576 | 245.1821 (64)  |
| 12Total per year (kWh/year)                                     |          |          |          |          |          |          |          | Total per year (kWh/year) = | Sum(64)m = |          |          | 2508.7076 (64) |
| Electric shower(s)                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                      | 0.0000     | 0.0000   | 0.0000   | 0.0000 (64a)   |
|                                                                 |          |          |          |          |          |          |          |                             |            |          |          | 0.0000 (64a)   |
| Heat gains from water heating, kWh/month                        | 88.9652  | 78.5792  | 83.2098  | 72.4901  | 69.8204  | 62.4234  | 61.2391  | 63.9369                     | 64.9353    | 72.9987  | 78.3469  | 87.9035 (65)   |

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

# Full SAP Calculation Printout



| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| (66)m                                                                               | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 141.9174  | 157.1228  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.3326  | 268.0859  | 261.1477  | 246.3769  | 227.7314  | 210.2073  | 198.5001  | 195.7468  | 202.6851  | 217.4559  | 236.1013  | 253.6254  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | (71) |
| Water heating gains (Table 5)                                                       | 119.5769  | 116.9333  | 111.8411  | 100.6807  | 93.8447   | 86.6992   | 82.3106   | 85.9367   | 90.1879   | 98.1165   | 108.8151  | 118.1499  | (72) |
| Total internal gains                                                                | 594.6305  | 609.9457  | 582.7098  | 561.5092  | 531.2971  | 508.3581  | 487.5317  | 488.4045  | 504.3246  | 525.2934  | 559.3680  | 581.4964  | (73) |

## 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| North       |          |          |          | 1.4200     | 10.6334                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 4.6146 (74)  |               |
| East        |          |          |          | 7.2100     | 19.6403                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 43.2767 (76) |               |
| West        |          |          |          | 7.0000     | 19.6403                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 42.0162 (80) |               |
|             |          |          |          |            |                                |           |                                   |                                    |                              |          |              |               |
| Solar gains | 89.9075  | 175.6698 | 289.7652 | 424.8203   | 523.5590                       | 537.4749  | 511.0589                          | 436.8657                           | 337.5975                     | 208.4804 | 112.0430     | 73.9877 (83)  |
| Total gains | 684.5380 | 785.6155 | 872.4750 | 986.3295   | 1054.8561                      | 1045.8330 | 998.5907                          | 925.2702                           | 841.9222                     | 733.7738 | 671.4110     | 655.4841 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |         |      |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |         |         |      |
| tau                                                                         | 67.1931 | 67.3979 | 67.5998 | 68.5646 | 68.7482 | 69.6159 | 69.6159 | 69.7790 | 69.2791 | 68.7482 | 68.3778 | 67.9949 | 67.9949 |      |
| alpha                                                                       | 5.4795  | 5.4932  | 5.5067  | 5.5710  | 5.5832  | 5.6411  | 5.6411  | 5.6519  | 5.6186  | 5.5832  | 5.5585  | 5.5330  | 5.5330  |      |
| util living area                                                            | 0.9986  | 0.9966  | 0.9907  | 0.9639  | 0.8803  | 0.7018  | 0.5279  | 0.5884  | 0.8491  | 0.9804  | 0.9967  | 0.9989  | 0.9989  | (86) |
| MIT                                                                         | 19.7244 | 19.8866 | 20.1449 | 20.5108 | 20.8053 | 20.9606 | 20.9933 | 20.9881 | 20.8847 | 20.4941 | 20.0525 | 19.7067 | 19.7067 | (87) |
| Th 2                                                                        | 19.9280 | 19.9309 | 19.9337 | 19.9471 | 19.9496 | 19.9613 | 19.9613 | 19.9635 | 19.9568 | 19.9496 | 19.9445 | 19.9392 | 19.9392 | (88) |
| util rest of house                                                          | 0.9980  | 0.9952  | 0.9868  | 0.9482  | 0.8313  | 0.6058  | 0.4074  | 0.4634  | 0.7719  | 0.9690  | 0.9952  | 0.9984  | 0.9984  | (89) |
| MIT 2                                                                       | 18.4464 | 18.6558 | 18.9867 | 19.4519 | 19.7896 | 19.9407 | 19.9595 | 19.9598 | 19.8812 | 19.4405 | 18.8787 | 18.4319 | 18.4319 | (90) |
| Living area fraction                                                        | 18.6607 | 18.8622 | 19.1809 | 19.6295 | 19.9600 | 20.1117 | 20.1329 | 20.1323 | 20.0495 | 19.6173 | 19.0756 | 18.6457 | 18.6457 | (91) |
| MIT                                                                         | 18.6607 | 18.8622 | 19.1809 | 19.6295 | 19.9600 | 20.1117 | 20.1329 | 20.1323 | 20.0495 | 19.6173 | 19.0756 | 18.6457 | 18.6457 | (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  | 0.0000  |      |
| adjusted MIT                                                                | 18.6607 | 18.8622 | 19.1809 | 19.6295 | 19.9600 | 20.1117 | 20.1329 | 20.1323 | 20.0495 | 19.6173 | 19.0756 | 18.6457 | 18.6457 | (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |               |           |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|-----------|-----------|-----------|-------|
| Utilisation                                                                    | 0.9970    | 0.9932    | 0.9829    | 0.9421    | 0.8318    | 0.6206   | 0.4277   | 0.4845   | 0.7799   | 0.9639        | 0.9932    | 0.9976    | 0.9976    | (94)  |
| Useful gains                                                                   | 682.4548  | 780.2986  | 857.5849  | 929.2300  | 877.4495  | 649.0893 | 427.1187 | 448.2988 | 656.6000 | 707.3172      | 666.8714  | 653.9106  | 653.9106  | (95)  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000       | 7.1000    | 4.2000    | 4.2000    | (96)  |
| Heat loss rate W                                                               | 1807.6200 | 1752.1193 | 1586.5739 | 1323.5342 | 1016.1837 | 669.6302 | 429.2159 | 452.3851 | 726.3317 | 1109.3493     | 1481.2777 | 1796.8759 | 1796.8759 | (97)  |
| Space heating kWh                                                              | 837.1229  | 653.0635  | 542.3678  | 283.8990  | 103.2183  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 299.1118      | 586.3725  | 850.3662  | 850.3662  | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |               |           | 4155.5221 | 4155.5221 |       |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000    | 0.0000    | 0.0000    | (98b) |
| Solar heating contribution - total per year (kWh/year)                         |           |           |           |           |           |          |          |          |          |               |           | 0.0000    | 0.0000    |       |
| Space heating kWh                                                              | 837.1229  | 653.0635  | 542.3678  | 283.8990  | 103.2183  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 299.1118      | 586.3725  | 850.3662  | 850.3662  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |               |           | 4155.5221 | 4155.5221 |       |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          | (98c) / (4) = |           | 39.2883   | 39.2883   | (99)  |

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

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |          |       |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000   | (201) |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000   | (202) |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 92.4000  | (206) |
| Efficiency of main space heating system 2 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000   | (207) |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000   | (208) |
| Space heating requirement                                             | 837.1229 | 653.0635 | 542.3678 | 283.8990 | 103.2183 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 299.1118 | 586.3725 | 850.3662 | 850.3662 | (98)  |
| Space heating efficiency (main heating system 1)                      | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 92.4000  | 92.4000  | 92.4000  | 92.4000  | (210) |
| Space heating fuel (main heating system)                              | 905.9772 | 706.7787 | 586.9781 | 307.2499 | 111.7081 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 323.7141 | 634.6023 | 920.3098 | 920.3098 | (211) |
| Space heating efficiency (main heating system 2)                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (212) |
| Space heating fuel (main heating system 2)                            | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (213) |
| Space heating fuel (secondary)                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215) |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |          |          |       |
| Water heating requirement                                             | 247.7744 | 219.0638 | 232.8618 | 205.3795 | 199.4504 | 180.1406 | 178.2294 | 185.1643 | 187.0081 | 207.9955 | 220.4576 | 245.1821 | 245.1821 | (64)  |
| Efficiency of water heater                                            | 86.7775  | 86.5711  | 86.1292  | 85.0754  | 83.0395  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 85.1592  | 86.3724  | 86.8191  | 86.8191  | (216) |
| Fuel for water heating, kWh/month                                     |          |          |          |          |          |          |          |          |          |          |          |          |          | (217) |

# Full SAP Calculation Printout



|                                                                                                      |          |          |          |           |           |           |           |           |           |          |          |            |        |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------|--------|
|                                                                                                      | 285.5285 | 253.0449 | 270.3633 | 241.4088  | 240.1874  | 224.3345  | 221.9545  | 230.5907  | 232.8868  | 244.2433 | 255.2407 | 282.4058   | (219)  |
| Space cooling fuel requirement                                                                       |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (221)m                                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (221)  |
| Pumps and Fa                                                                                         | 7.3041   | 6.5973   | 7.3041   | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041   | 7.0685   | 7.3041     | (231)  |
| Lighting                                                                                             | 29.4876  | 23.6561  | 21.2997  | 15.6051   | 12.0538   | 9.8481    | 10.9959   | 14.2929   | 18.5650   | 24.3583  | 27.5126  | 30.3072    | (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (233a)m                                                                                              | -38.9155 | -55.5613 | -80.8490 | -92.0318  | -100.1559 | -93.7669  | -92.5734  | -86.9330  | -77.1467  | -64.0142 | -43.0168 | -33.5605   | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (234a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235c)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (233b)m                                                                                              | -19.9013 | -42.0938 | -84.1047 | -126.9762 | -168.5551 | -169.6411 | -167.6836 | -141.7059 | -103.4811 | -60.4596 | -26.6523 | -15.7233   | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (234b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235d)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235d) |
| Annual totals kWh/year                                                                               |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Space heating fuel - main system 1                                                                   |          |          |          |           |           |           |           |           |           |          |          | 4497.3183  | (211)  |
| Space heating fuel - main system 2                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (213)  |
| Space heating fuel - secondary                                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (215)  |
| Efficiency of water heater                                                                           |          |          |          |           |           |           |           |           |           |          |          | 80.3000    |        |
| Water heating fuel used                                                                              |          |          |          |           |           |           |           |           |           |          |          | 2982.1891  | (219)  |
| Space cooling fuel                                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (221)  |
| Electricity for pumps and fans:                                                                      |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Total electricity for the above, kWh/year                                                            |          |          |          |           |           |           |           |           |           |          |          | 86.0000    | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                  |          |          |          |           |           |           |           |           |           |          |          | 237.9821   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| PV generation                                                                                        |          |          |          |           |           |           |           |           |           |          |          | -1985.5029 | (233)  |
| Wind generation                                                                                      |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (234)  |
| Hydro-electric generation (Appendix N)                                                               |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (235a) |
| Electricity generated - Micro CHP (Appendix N)                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (235)  |
| Appendix Q - special features                                                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Energy saved or generated                                                                            |          |          |          |           |           |           |           |           |           |          |          | -0.0000    | (236)  |
| Energy used                                                                                          |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (237)  |
| Total delivered energy for all uses                                                                  |          |          |          |           |           |           |           |           |           |          |          | 5817.9866  | (238)  |

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

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 4497.3183          | 0.2100                        | 944.4368 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2982.1891          | 0.2100                        | 626.2597 (264)           |
| Space and water heating                       |                    |                               | 1570.6965 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 237.9821           | 0.1443                        | 34.3482 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -858.5249          | 0.1343                        | -115.3320                |
| PV Unit electricity exported                  | -1126.9779         | 0.1257                        | -141.7033                |
| Total                                         |                    |                               | -257.0353 (269)          |
| Total CO2, kg/year                            |                    |                               | 1359.9387 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 12.8600 (273)            |

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

|                                             | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1               | 4497.3183          | 1.1300                              | 5081.9696 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2982.1891          | 1.1300                              | 3369.8737 (278)            |
| Space and water heating                     |                    |                                     | 8451.8433 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 237.9821           | 1.5338                              | 365.0249 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -858.5249          | 1.4965                              | -1284.7605                 |
| PV Unit electricity exported                | -1126.9779         | 0.4615                              | -520.1396                  |
| Total                                       |                    |                                     | -1804.9001 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 7142.0689 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 67.5200 (287)              |

# Full SAP Calculation Printout



|                                    |                        |               |       |               |                |            |  |
|------------------------------------|------------------------|---------------|-------|---------------|----------------|------------|--|
| Property Reference                 | SAP VG 21-0282         |               |       |               | Issued on Date | 15/11/2024 |  |
| Assessment Reference               | Plot 54                |               |       | Prop Type Ref | SAP VG 21-0282 |            |  |
| Property                           |                        |               |       |               |                |            |  |
|                                    |                        |               |       |               |                |            |  |
| SAP Rating                         | 93 A                   | DER           | 12.81 | TER           | 12.86          |            |  |
| Environmental                      | 88 B                   | % DER < TER   |       |               |                | 0.39       |  |
| CO <sub>2</sub> Emissions (t/year) | 1.3                    | DFEE          | 41.49 | TFEE          | 44.09          |            |  |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |               |                | 5.89       |  |
| % DPER < TPER                      | 0.23                   | DPER          | 67.36 | TPER          | 67.52          |            |  |
|                                    |                        |               |       |               |                |            |  |
| Assessor Details                   | Miss Victoria Gartside |               |       |               | Assessor ID    | AL30-0001  |  |
| Client                             |                        |               |       |               |                |            |  |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF FABRIC ENERGY EFFICIENCY

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 25.4100 (1b)              | x 2.8400 (2b)                     | = 72.1644 (1b) - (3b)       |
| First floor                                            | 40.1800 (1c)              | x 2.3900 (2c)                     | = 96.0302 (1c) - (3c)       |
| Second floor                                           | 40.1800 (1d)              | x 2.6000 (2d)                     | = 104.4680 (1d) - (3d)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700                  |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 272.6626 (5)                |

## 2. Ventilation rate

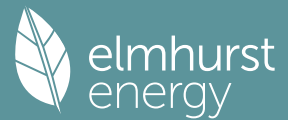
|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of open chimneys                                                                            | 0 * 80 = 0.0000 (6a)                    |
| Number of open flues                                                                               | 0 * 20 = 0.0000 (6b)                    |
| Number of chimneys / flues attached to closed fire                                                 | 0 * 10 = 0.0000 (6c)                    |
| Number of flues attached to solid fuel boiler                                                      | 0 * 20 = 0.0000 (6d)                    |
| Number of flues attached to other heater                                                           | 0 * 35 = 0.0000 (6e)                    |
| Number of blocked chimneys                                                                         | 0 * 20 = 0.0000 (6f)                    |
| Number of intermittent extract fans                                                                | 4 * 10 = 40.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) = 0.1467 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 4.0000 (17)                             |
| Infiltration rate                                                                                  | 0.3467 (18)                             |
| Number of sides sheltered                                                                          | 1 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3207 (21)        |

|                                                                                                         | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|---------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed                                                                                              | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor                                                                                             | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate                                                                                         | 0.4089 | 0.4009 | 0.3929 | 0.3528 | 0.3448 | 0.3047 | 0.3047 | 0.2966 | 0.3207 | 0.3448 | 0.3608 | 0.3768 (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23c) |
| Effective ac                                                                                            | 0.5836 | 0.5803 | 0.5772 | 0.5622 | 0.5594 | 0.5464 | 0.5464 | 0.5440 | 0.5514 | 0.5594 | 0.5651 | 0.5710 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                                                  | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K    |
|--------------------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------|
| Solid front door                                                         |                         |                            | 2.1400                    | 1.1000                        | 2.3540       |                                | (26)             |
| Windows (Uw = 1.30)                                                      |                         |                            | 15.6300                   | 1.2357                        | 19.3146      |                                | (27)             |
| Ground floor                                                             |                         |                            | 25.4100                   | 0.1300                        | 3.3033       | 0.0000                         | 0.0000 (28a)     |
| Exposed floor                                                            |                         |                            | 14.7600                   | 0.2000                        | 2.9520       | 20.0000                        | 295.2000 (28b)   |
| Brick wall                                                               | 125.8800                | 17.7700                    | 108.1100                  | 0.1900                        | 20.5409      | 110.0000                       | 11892.1000 (29a) |
| Retaining wall                                                           | 12.9200                 |                            | 12.9200                   | 0.1800                        | 2.3256       | 110.0000                       | 1421.2000 (29a)  |
| Garage wall                                                              | 21.3200                 |                            | 21.3200                   | 0.1400                        | 2.9848       | 110.0000                       | 2345.2000 (29a)  |
| Plane roof                                                               | 40.1800                 |                            | 40.1800                   | 0.0900                        | 3.6162       | 9.0000                         | 361.6200 (30)    |
| Total net area of external elements A <sub>um</sub> (A, m <sup>2</sup> ) |                         |                            | 240.4700                  |                               |              |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                                      |                         |                            |                           | (26)...(30) + (32) =          | 57.3914      |                                | (33)             |
| Party Wall 1                                                             |                         |                            | 69.1400                   | 0.0000                        | 0.0000       | 140.0000                       | 9679.6000 (32)   |
| Internal Wall                                                            |                         |                            | 18.2000                   |                               |              | 75.0000                        | 1365.0000 (32c)  |
| Internal Wall                                                            |                         |                            | 146.3400                  |                               |              | 9.0000                         | 1317.0600 (32c)  |
| Internal Floor 1                                                         |                         |                            | 65.5900                   |                               |              | 18.0000                        | 1180.6200 (32d)  |
| Internal Ceiling 1                                                       |                         |                            | 65.5900                   |                               |              | 9.0000                         | 590.3100 (32e)   |

# Full SAP Calculation Printout



Heat capacity  $C_m = \text{Sum}(A \times k)$   
Thermal mass parameter (TMP) =  $C_m / \text{TFA}$  in  $\text{kJ/m}^2\text{K}$   
List of Thermal Bridges

|                                                                  |
|------------------------------------------------------------------|
| K1 Element                                                       |
| E2 Other lintels (including other steel lintels)                 |
| E3 Sill                                                          |
| E4 Jamb                                                          |
| E5 Ground floor (normal)                                         |
| E6 Intermediate floor within a dwelling                          |
| E10 Eaves (insulation at ceiling level)                          |
| E12 Gable (insulation at ceiling level)                          |
| E16 Corner (normal)                                              |
| E17 Corner (inverted - internal area greater than external area) |
| E20 Exposed floor (normal)                                       |
| E21 Exposed floor (inverted)                                     |
| E18 Party wall between dwellings                                 |
| P1 Party wall - Ground floor                                     |
| P2 Party wall - Intermediate floor within a dwelling             |
| P4 Party wall - Roof (insulation at ceiling level)               |

(28)...(30) + (32) + (32a)...(32e) = 30447.9100 (34)  
287.8691 (35)

Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Point Thermal bridges (36a) = 0.0000  
Total fabric heat loss (33) + (36) + (36a) = 70.0868 (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                     | 52.5112  | 52.2191  | 51.9328  | 50.5881  | 50.3365  | 49.1652  | 49.1652  | 48.9483  | 49.6164  | 50.3365  | 50.8454  | 51.3776  | (38) |
| Heat transfer coeff       | 122.5980 | 122.3059 | 122.0196 | 120.6749 | 120.4233 | 119.2521 | 119.2521 | 119.0352 | 119.7032 | 120.4233 | 120.9323 | 121.4644 | (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 120.6737 |      |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| HLP           | 1.1591 | 1.1563 | 1.1536 | 1.1409 | 1.1385 | 1.1275 | 1.1275 | 1.1254 | 1.1317 | 1.1385 | 1.1434 | 1.1484 | (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1409 |      |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |      |

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

|                                                                                |          |          |          |         |         |         |         |         |         |         |          |          |             |
|--------------------------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|----------|-------------|
| Assumed occupancy                                                              |          |          |          |         |         |         |         |         |         |         |          |          | 2.7869 (42) |
| Hot water usage for mixer showers                                              |          |          |          |         |         |         |         |         |         |         |          |          |             |
| 0.0000                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (42a)       |
| Hot water usage for baths                                                      |          |          |          |         |         |         |         |         |         |         |          |          |             |
| 30.6328                                                                        | 30.1778  | 29.5372  | 28.3559  | 27.4714 | 26.4907 | 25.9609 | 26.5971 | 27.2897 | 28.3392 | 29.5448 | 30.5292  | 30.5292  | (42b)       |
| Hot water usage for other uses                                                 |          |          |          |         |         |         |         |         |         |         |          |          |             |
| 43.1707                                                                        | 41.6009  | 40.0310  | 38.4612  | 36.8913 | 35.3215 | 35.3215 | 36.8913 | 38.4612 | 40.0310 | 41.6009 | 43.1707  | 43.1707  | (42c)       |
| Average daily hot water use (litres/day)                                       |          |          |          |         |         |         |         |         |         |         |          | 67.6475  | (43)        |
|                                                                                | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov      | Dec      |             |
| Daily hot water use                                                            | 73.8035  | 71.7787  | 69.5682  | 66.8171 | 64.3628 | 61.8122 | 61.2824 | 63.4884 | 65.7509 | 68.3702 | 71.1456  | 73.6999  | (44)        |
| Energy content (annual)                                                        | 116.8867 | 102.2119 | 106.9237 | 91.4693 | 86.6447 | 76.0053 | 74.1157 | 78.6119 | 81.0775 | 92.7778 | 101.3600 | 115.3963 | (45)        |
| Distribution loss (46)m = $0.15 \times (45)\text{m}$                           | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (46)        |
| Water storage loss:                                                            |          |          |          |         |         |         |         |         |         |         |          |          |             |
| Total storage loss                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (56)        |
| If cylinder contains dedicated solar storage                                   |          |          |          |         |         |         |         |         |         |         |          |          |             |
| 0.0000                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (57)        |
| Primary loss                                                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (59)        |
| Combi loss                                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (61)        |
| Total heat required for water heating calculated for each month                |          |          |          |         |         |         |         |         |         |         |          |          |             |
| 99.3537                                                                        | 86.8801  | 90.8852  | 77.7489  | 73.6480 | 64.6045 | 62.9984 | 66.8201 | 68.9158 | 78.8611 | 86.1560 | 98.0868  | 98.0868  | (62)        |
| WWHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (63a)       |
| PV diverter                                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (63b)       |
| Solar input                                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (63c)       |
| FGHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000   | 0.0000   | (63d)       |
| Output from w/h                                                                | 99.3537  | 86.8801  | 90.8852  | 77.7489 | 73.6480 | 64.6045 | 62.9984 | 66.8201 | 68.9158 | 78.8611 | 86.1560  | 98.0868  | (64)        |
| Total per year (kWh/year)                                                      |          |          |          |         |         |         |         |         |         |         |          | 954.9586 | (64)        |
| Electric shower(s)                                                             | 56.8168  | 50.6242  | 55.2797  | 52.7527 | 53.7426 | 51.2652 | 52.9741 | 53.7426 | 52.7527 | 55.2797 | 54.2402  | 56.8168  | (64a)       |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |         |         |         |         |         |         |         |          | 646.2874 | (64a)       |
| Heat gains from water heating, kWh/month                                       |          |          |          |         |         |         |         |         |         |         |          |          |             |
| 39.0426                                                                        | 34.3761  | 36.5412  | 32.6254  | 31.8476 | 28.9674 | 28.9931 | 30.1407 | 30.4171 | 33.5352 | 35.0991 | 38.7259  | 38.7259  | (65)        |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| (66)m                                                                               | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 141.9174                                                                            | 157.1228  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | 141.9174  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 265.3326                                                                            | 268.0859  | 261.1477  | 246.3769  | 227.7314  | 210.2073  | 198.5001  | 195.7468  | 202.6851  | 217.4559  | 236.1013  | 253.6254  | 253.6254  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 36.9345                                                                             | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |           |      |
| -111.4763                                                                           | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |           |      |
| 52.4766                                                                             | 51.1549   | 49.1145   | 45.3131   | 42.8060   | 40.2325   | 38.9692   | 40.5117   | 42.2460   | 45.0742   | 48.7487   | 52.0509   | 52.0509   | (72) |
| Total internal gains                                                                | 524.5302  | 541.1673  | 516.9832  | 503.1415  | 477.2584  | 461.8914  | 444.1904  | 442.9795  | 456.3827  | 469.2511  | 496.3016  | 512.3974  | (73) |

## 6. Solar gains

| [Jan] | Area<br>m <sup>2</sup> | Solar flux<br>Table 6a<br>W/m <sup>2</sup> | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W |
|-------|------------------------|--------------------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|
|-------|------------------------|--------------------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|

# Full SAP Calculation Printout



|       |        |         |        |        |        |              |
|-------|--------|---------|--------|--------|--------|--------------|
| North | 1.4200 | 10.6334 | 0.7300 | 0.7000 | 0.7700 | 5.3471 (74)  |
| East  | 7.2100 | 19.6403 | 0.7300 | 0.7000 | 0.7700 | 50.1460 (76) |
| West  | 7.0000 | 19.6403 | 0.7300 | 0.7000 | 0.7700 | 48.6855 (80) |

|             |          |          |          |          |           |           |           |          |          |          |          |               |
|-------------|----------|----------|----------|----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|
| Solar gains | 104.1786 | 203.5539 | 335.7596 | 492.2521 | 606.6636  | 622.7884  | 592.1794  | 506.2095 | 391.1845 | 241.5726 | 129.8276 | 85.7318 (83)  |
| Total gains | 628.7088 | 744.7212 | 852.7428 | 995.3936 | 1083.9220 | 1084.6798 | 1036.3697 | 949.1889 | 847.5672 | 710.8236 | 626.1292 | 598.1292 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 68.9877                   | 69.1524 | 69.3147 | 70.0871 | 70.2335 | 70.9233 | 70.9233 | 71.0525 | 70.6560 | 70.2335 | 69.9379 | 69.6315      |
| alpha                                                                       | 5.5992                    | 5.6102  | 5.6210  | 5.6725  | 5.6822  | 5.7282  | 5.7282  | 5.7368  | 5.7104  | 5.6822  | 5.6625  | 5.6421       |
| util living area                                                            | 0.9991                    | 0.9973  | 0.9914  | 0.9607  | 0.8639  | 0.6729  | 0.5012  | 0.5662  | 0.8398  | 0.9823  | 0.9977  | 0.9993 (86)  |
| MIT                                                                         | 19.7173                   | 19.8911 | 20.1643 | 20.5433 | 20.8336 | 20.9697 | 20.9952 | 20.9908 | 20.8963 | 20.4975 | 20.0429 | 19.6937 (87) |
| Th 2                                                                        | 19.9529                   | 19.9551 | 19.9573 | 19.9676 | 19.9695 | 19.9785 | 19.9785 | 19.9801 | 19.9750 | 19.9695 | 19.9656 | 19.9615 (88) |
| util rest of house                                                          | 0.9987                    | 0.9963  | 0.9878  | 0.9441  | 0.8121  | 0.5790  | 0.3877  | 0.4465  | 0.7616  | 0.9719  | 0.9965  | 0.9990 (89)  |
| MIT 2                                                                       | 18.7860                   | 18.9611 | 19.2338 | 19.6087 | 19.8646 | 19.9664 | 19.9775 | 19.9780 | 19.9226 | 19.5728 | 19.1212 | 18.7693 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         | 0.1677 (91)  |
| MIT                                                                         | 18.9422                   | 19.1171 | 19.3899 | 19.7655 | 20.0271 | 20.1347 | 20.1482 | 20.1478 | 20.0859 | 19.7279 | 19.2758 | 18.9243 (92) |
| Temperature adjustment                                                      | 0.0000                    |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 18.9422                   | 19.1171 | 19.3899 | 19.7655 | 20.0271 | 20.1347 | 20.1482 | 20.1478 | 20.0859 | 19.7279 | 19.2758 | 18.9243 (93) |

## 8. Space heating requirement

|                                                                                |                            |           |           |           |           |          |          |          |          |           |           |                |
|--------------------------------------------------------------------------------|----------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|----------------|
|                                                                                | Jan                        | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec            |
| Utilisation                                                                    | 0.9982                     | 0.9951    | 0.9851    | 0.9400    | 0.8154    | 0.5941   | 0.4068   | 0.4667   | 0.7713   | 0.9686    | 0.9954    | 0.9986 (94)    |
| Useful gains                                                                   | 627.5596                   | 741.0505  | 840.0158  | 935.6722  | 883.7931  | 644.4561 | 421.6425 | 442.9963 | 653.7261 | 688.5166  | 623.2802  | 597.3043 (95)  |
| Ext temp.                                                                      | 4.3000                     | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000   | 7.1000    | 4.2000 (96)    |
| Heat loss rate W                                                               | 1795.1033                  | 1738.8299 | 1572.8199 | 1311.1907 | 1002.7827 | 660.0190 | 423.1254 | 446.1248 | 716.5316 | 1099.2125 | 1472.4462 | 1788.4782 (97) |
| Space heating kWh                                                              | 868.6525                   | 670.5078  | 545.2063  | 270.3733  | 88.5283   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 305.5577  | 611.3995  | 886.2334 (98a) |
| Space heating requirement - total per year (kWh/year)                          | 4246.4589                  |           |           |           |           |          |          |          |          |           |           |                |
| Solar heating kWh                                                              | 0.0000                     | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         | 0.0000                     |           |           |           |           |          |          |          |          |           |           |                |
| Space heating kWh                                                              | 868.6525                   | 670.5078  | 545.2063  | 270.3733  | 88.5283   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 305.5577  | 611.3995  | 886.2334 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | 4246.4589                  |           |           |           |           |          |          |          |          |           |           |                |
| Space heating per m2                                                           | (98c) / (4) = 40.1480 (99) |           |           |           |           |          |          |          |          |           |           |                |

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

|                                  | Jan                      | Feb    | Mar    | Apr    | May     | Jun       | Jul       | Aug       | Sep     | Oct     | Nov    | Dec            |
|----------------------------------|--------------------------|--------|--------|--------|---------|-----------|-----------|-----------|---------|---------|--------|----------------|
| Ext. temp.                       | 4.3000                   | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000   | 16.6000   | 16.4000   | 14.1000 | 10.6000 | 7.1000 | 4.2000         |
| Heat loss rate W                 | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1120.9695 | 882.4653  | 904.6674  | 0.0000  | 0.0000  | 0.0000 | 0.0000 (100)   |
| Utilisation                      | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.8802    | 0.9388    | 0.9077    | 0.0000  | 0.0000  | 0.0000 | 0.0000 (101)   |
| Useful loss                      | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 986.6670  | 828.4914  | 821.1254  | 0.0000  | 0.0000  | 0.0000 | 0.0000 (102)   |
| Total gains                      | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1204.5730 | 1151.0595 | 1052.0312 | 0.0000  | 0.0000  | 0.0000 | 0.0000 (103)   |
| Space cooling kWh                | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 156.8923  | 239.9906  | 171.7939  | 0.0000  | 0.0000  | 0.0000 | 0.0000 (104)   |
| Cooled fraction                  | fc = cooled area / (4) = |        |        |        |         |           |           |           |         |         |        | 1.0000 (105)   |
| Intermittency factor (Table 10b) | 0.2500                   | 0.2500 | 0.2500 | 0.2500 | 0.2500  | 0.2500    | 0.2500    | 0.2500    | 0.2500  | 0.2500  | 0.2500 | 0.2500 (106)   |
| Space cooling kWh                | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 39.2231   | 59.9977   | 42.9485   | 0.0000  | 0.0000  | 0.0000 | 0.0000 (107)   |
| Space cooling requirement        |                          |        |        |        |         |           |           |           |         |         |        | 142.1692 (107) |
| Energy for space heating         |                          |        |        |        |         |           |           |           |         |         |        | 40.1480 (99)   |
| Energy for space cooling         |                          |        |        |        |         |           |           |           |         |         |        | 1.3441 (108)   |
| Total                            |                          |        |        |        |         |           |           |           |         |         |        | 41.4922 (109)  |
| Fabric Energy Efficiency (DFEE)  |                          |        |        |        |         |           |           |           |         |         |        | 41.5 (109)     |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

## 1. Overall dwelling characteristics

|                                                        |              |                                 |                        |
|--------------------------------------------------------|--------------|---------------------------------|------------------------|
|                                                        | Area (m2)    | Storey height (m)               | Volume (m3)            |
| Ground floor                                           | 25.4100 (1b) | x 2.8400 (2b)                   | = 72.1644 (1b) - (3b)  |
| First floor                                            | 40.1800 (1c) | x 2.3900 (2c)                   | = 96.0302 (1c) - (3c)  |
| Second floor                                           | 40.1800 (1d) | x 2.6000 (2d)                   | = 104.4680 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700     |                                 | (4)                    |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 272.6626 (5)         |

## 2. Ventilation rate

m3 per hour

# Full SAP Calculation Printout



Number of open chimneys  
Number of open flues  
Number of chimneys / flues attached to closed fire  
Number of flues attached to solid fuel boiler  
Number of flues attached to other heater  
Number of blocked chimneys  
Number of intermittent extract fans  
Number of passive vents  
Number of flueless gas fires

0 \* 80 = 0.0000 (6a)  
0 \* 20 = 0.0000 (6b)  
0 \* 10 = 0.0000 (6c)  
0 \* 20 = 0.0000 (6d)  
0 \* 35 = 0.0000 (6e)  
0 \* 20 = 0.0000 (6f)  
4 \* 10 = 40.0000 (7a)  
0 \* 10 = 0.0000 (7b)  
0 \* 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 40.0000 / (5) = 0.1467 (8)  
Pressure test  
Pressure Test Method  
Measured/design AP50  
Infiltration rate  
Number of sides sheltered  
Blower Door  
5.0000 (17)  
0.3967 (18)  
1 (19)  
Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)  
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3669 (21)

|                                                                                                         | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|---------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed                                                                                              | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor                                                                                             | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate                                                                                         | 0.4679 | 0.4587 | 0.4495 | 0.4036 | 0.3945 | 0.3486 | 0.3486 | 0.3394 | 0.3669 | 0.3945 | 0.4128 | 0.4312 (22b) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =            |        |        |        |        |        |        |        |        |        |        |        | 0.0000 (23c) |
| Effective ac                                                                                            | 0.6094 | 0.6052 | 0.6010 | 0.5815 | 0.5778 | 0.5608 | 0.5608 | 0.5576 | 0.5673 | 0.5778 | 0.5852 | 0.5930 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                        | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |
|------------------------------------------------|-------------|----------------|---------------|------------------|--------------|-------------------|---------------|
| TER Opaque door                                |             |                | 2.1400        | 1.0000           | 2.1400       |                   | (26)          |
| TER Opening Type (Uw = 1.20)                   |             |                | 15.6300       | 1.1450           | 17.8969      |                   | (27)          |
| Ground floor                                   |             |                | 25.4100       | 0.1300           | 3.3033       |                   | (28a)         |
| Exposed floor                                  |             |                | 14.7600       | 0.1300           | 1.9188       |                   | (28b)         |
| Brick wall                                     | 125.8800    | 17.7700        | 108.1100      | 0.1800           | 19.4598      |                   | (29a)         |
| Retaining wall                                 | 12.9200     |                | 12.9200       | 0.1800           | 2.3256       |                   | (29a)         |
| Garage wall                                    | 21.3200     |                | 21.3200       | 0.1800           | 3.8376       |                   | (29a)         |
| Plane roof                                     | 40.1800     |                | 40.1800       | 0.1100           | 4.4198       |                   | (30)          |
| Total net area of external elements Aum(A, m2) |             |                | 240.4700      |                  |              |                   | (31)          |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               |                  | 55.3018      |                   | (33)          |
| Party Wall 1                                   |             |                | 69.1400       | 0.0000           | 0.0000       |                   | (32)          |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 287.8691 (35)

### List of Thermal Bridges

| K1 Element                                                       | Length  | Psi-value | Total   |
|------------------------------------------------------------------|---------|-----------|---------|
| E2 Other lintels (including other steel lintels)                 | 12.3300 | 0.0500    | 0.6165  |
| E3 Sill                                                          | 9.5000  | 0.0500    | 0.4750  |
| E4 Jamb                                                          | 30.3000 | 0.0500    | 1.5150  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.1600    | 3.2304  |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0000    | 0.0000  |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460  |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0600    | 0.5310  |
| E16 Corner (normal)                                              | 18.5000 | 0.0900    | 1.6650  |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0900   | -0.5112 |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.3200    | 2.5568  |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032  |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0600    | 0.9396  |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0800    | 0.7064  |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000    | 0.0000  |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.1200    | 1.0596  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 15.7333 (36)

### Point Thermal Bridges

Total fabric heat loss (33) + (36) + (36a) = 71.0351 (37)

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

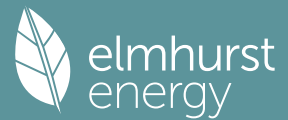
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 54.8372  | 54.4548  | 54.0799  | 52.3194  | 51.9900  | 50.4566  | 50.4566  | 50.1726  | 51.0472  | 51.9900  | 52.6563  | 53.3530 (38)  |
| Heat transfer coeff       | 125.8723 | 125.4899 | 125.1151 | 123.3545 | 123.0251 | 121.4917 | 121.4917 | 121.2077 | 122.0824 | 123.0251 | 123.6915 | 124.3881 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 123.3529      |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1901 | 1.1864 | 1.1829 | 1.1663 | 1.1631 | 1.1486 | 1.1486 | 1.1460 | 1.1542 | 1.1631 | 1.1694 | 1.1760 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1662      |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31          |

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

Assumed occupancy 2.7869 (42)  
Hot water usage for mixer showers 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (42a)  
Hot water usage for baths 30.6328 30.1778 29.5372 28.3559 27.4714 26.4907 25.9609 26.5971 27.2897 28.3392 29.5448 30.5292 (42b)  
Hot water usage for other uses 43.1707 41.6009 40.0310 38.4612 36.8913 35.3215 35.3215 36.8913 38.4612 40.0310 41.6009 43.1707 (42c)  
Average daily hot water use (litres/day) 67.6475 (43)  
Daily hot water use  
Jan 73.8035 Feb 71.7787 Mar 69.5682 Apr 66.8171 May 64.3628 Jun 61.8122 Jul 61.2824 Aug 63.4884 Sep 65.7509 Oct 68.3702 Nov 71.1456 Dec 73.6999 (44)  
Energy conte 116.8867 102.2119 106.9237 91.4693 86.6447 76.0053 74.1157 78.6119 81.0775 92.7778 101.3600 115.3963 (45)  
Energy content (annual)  
Distribution loss (46)m = 0.15 x (45)m  
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (46)  
Water storage loss:  
Total storage loss  
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)  
If cylinder contains dedicated solar storage

# Full SAP Calculation Printout



|                                                                 |         |         |         |         |         |         |         |         |         |         |         |                |
|-----------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------------|
|                                                                 | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (57)    |
| Primary loss                                                    | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (59)    |
| Combi loss                                                      | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (61)    |
| Total heat required for water heating calculated for each month |         |         |         |         |         |         |         |         |         |         |         |                |
|                                                                 | 99.3537 | 86.8801 | 90.8852 | 77.7489 | 73.6480 | 64.6045 | 62.9984 | 66.8201 | 68.9158 | 78.8611 | 86.1560 | 98.0868 (62)   |
| WWHRS                                                           | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63a)   |
| PV diverter                                                     | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63b)   |
| Solar input                                                     | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63c)   |
| FGHRS                                                           | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000  | 0.0000 (63d)   |
| Output from w/h                                                 |         |         |         |         |         |         |         |         |         |         |         |                |
|                                                                 | 99.3537 | 86.8801 | 90.8852 | 77.7489 | 73.6480 | 64.6045 | 62.9984 | 66.8201 | 68.9158 | 78.8611 | 86.1560 | 98.0868 (64)   |
| 12Total per year (kWh/year)                                     |         |         |         |         |         |         |         |         |         |         |         | 954.9586 (64)  |
| Electric shower(s)                                              |         |         |         |         |         |         |         |         |         |         |         | 955 (64)       |
|                                                                 | 56.8168 | 50.6242 | 55.2797 | 52.7527 | 53.7426 | 51.2652 | 52.9741 | 53.7426 | 52.7527 | 55.2797 | 54.2402 | 56.8168 (64a)  |
|                                                                 |         |         |         |         |         |         |         |         |         |         |         | 646.2874 (64a) |
| Heat gains from water heating, kWh/month                        |         |         |         |         |         |         |         |         |         |         |         |                |
|                                                                 | 39.0426 | 34.3761 | 36.5412 | 32.6254 | 31.8476 | 28.9674 | 28.9931 | 30.1407 | 30.4171 | 33.5352 | 35.0991 | 38.7259 (65)   |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 141.9174  | 157.1228  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.3326  | 268.0859  | 261.1477  | 246.3769  | 227.7314  | 210.2073  | 198.5001  | 195.7468  | 202.6851  | 217.4559  | 236.1013  | 253.6254  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | (69) |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | (71) |
| Water heating gains (Table 5)                                                       | 52.4766   | 51.1549   | 49.1145   | 45.3131   | 42.8060   | 40.2325   | 38.9692   | 40.5117   | 42.2460   | 45.0742   | 48.7487   | 52.0509   | (72) |
| Total internal gains                                                                | 524.5302  | 541.1673  | 516.9832  | 503.1415  | 477.2584  | 461.8914  | 444.1904  | 442.9795  | 456.3827  | 469.2511  | 496.3016  | 512.3974  | (73) |

## 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| North       |          |          |          | 1.4200     | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       | 4.6146 (74)  |          |          |               |
| East        |          |          |          | 7.2100     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 43.2767 (76) |          |          |               |
| West        |          |          |          | 7.0000     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 42.0162 (80) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 89.9075  | 175.6698 | 289.7652 | 424.8203   | 523.5590                       | 537.4749                          | 511.0589                           | 436.8657                     | 337.5975     | 208.4804 | 112.0430 | 73.9877 (83)  |
| Total gains | 614.4378 | 716.8371 | 806.7484 | 927.9618   | 1000.8174                      | 999.3663                          | 955.2493                           | 879.8452                     | 793.9802     | 677.7315 | 608.3446 | 586.3851 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 67.1931 | 67.3979 | 67.5998 | 68.5646 | 68.7482 | 69.6159 | 69.6159 | 69.7790 | 69.2791 | 68.7482 | 68.3778 | 67.9949 |              |
| alpha                                                                       | 5.4795  | 5.4932  | 5.5067  | 5.5710  | 5.5832  | 5.6411  | 5.6411  | 5.6519  | 5.6186  | 5.5832  | 5.5585  | 5.5330  |              |
| util living area                                                            | 0.9992  | 0.9978  | 0.9936  | 0.9720  | 0.8987  | 0.7264  | 0.5501  | 0.6152  | 0.8728  | 0.9863  | 0.9980  | 0.9994  | (86)         |
| MIT                                                                         | 19.6618 | 19.8257 | 20.0884 | 20.4668 | 20.7790 | 20.9532 | 20.9918 | 20.9853 | 20.8649 | 20.4481 | 19.9965 | 19.6447 | (87)         |
| Th 2                                                                        | 19.9280 | 19.9309 | 19.9337 | 19.9471 | 19.9496 | 19.9613 | 19.9613 | 19.9635 | 19.9568 | 19.9496 | 19.9445 | 19.9392 | (88)         |
| util rest of house                                                          | 0.9988  | 0.9969  | 0.9908  | 0.9592  | 0.8540  | 0.6302  | 0.4255  | 0.4864  | 0.8011  | 0.9779  | 0.9970  | 0.9991  | (89)         |
| MIT 2                                                                       | 18.7109 | 18.8767 | 19.1402 | 19.5205 | 19.8049 | 19.9418 | 19.9595 | 19.9599 | 19.8854 | 19.5093 | 19.0583 | 18.7027 | (90)         |
| Living area fraction                                                        | 18.8704 | 19.0359 | 19.2992 | 19.6792 | 19.9683 | 20.1115 | 20.1327 | 20.1319 | 20.0497 | 19.6668 | 19.2157 | 18.8607 | (91)         |
| MIT                                                                         | 18.8704 | 19.0359 | 19.2992 | 19.6792 | 19.9683 | 20.1115 | 20.1327 | 20.1319 | 20.0497 | 19.6668 | 19.2157 | 18.8607 | (92)         |
| Temperature adjustment                                                      | 18.8704 | 19.0359 | 19.2992 | 19.6792 | 19.9683 | 20.1115 | 20.1327 | 20.1319 | 20.0497 | 19.6668 | 19.2157 | 18.8607 | (93)         |
| adjusted MIT                                                                | 18.8704 | 19.0359 | 19.2992 | 19.6792 | 19.9683 | 20.1115 | 20.1327 | 20.1319 | 20.0497 | 19.6668 | 19.2157 | 18.8607 | (93)         |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |           |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |       |
| Useful gains                                                                   | 0.9983    | 0.9959    | 0.9885    | 0.9550    | 0.8549    | 0.6452   | 0.4466   | 0.5082   | 0.8087   | 0.9748    | 0.9960    | 0.9987    | (94)  |
| Ext temp.                                                                      | 613.4162  | 713.8847  | 797.4624  | 886.2407  | 855.5972  | 644.7782 | 426.5867 | 447.1525 | 642.0873 | 660.6192  | 605.9303  | 585.6377  | (95)  |
| Heat loss rate W                                                               | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000   | 7.1000    | 4.2000    | (96)  |
| Space heating kWh                                                              | 1834.0094 | 1773.9098 | 1601.3713 | 1329.6631 | 1017.2025 | 669.5961 | 429.1906 | 452.3297 | 726.3517 | 1115.4407 | 1498.6051 | 1823.6207 | (97)  |
| Space heating requirement - total per year (kWh/year)                          | 908.1213  | 712.3368  | 598.1082  | 319.2642  | 120.2343  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 338.3872  | 642.7258  | 921.0594  | (98a) |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | (98b) |
| Solar heating contribution - total per year (kWh/year)                         | 908.1213  | 712.3368  | 598.1082  | 319.2642  | 120.2343  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 338.3872  | 642.7258  | 921.0594  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | 908.1213  | 712.3368  | 598.1082  | 319.2642  | 120.2343  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 338.3872  | 642.7258  | 921.0594  | (98c) |
| Space heating per m <sup>2</sup>                                               |           |           |           |           |           |          |          |          |          |           |           |           | (99)  |

## 8c. Space cooling requirement

|                                                     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Calculated for June, July and August. See Table 10b | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-----------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

# Full SAP Calculation Printout



|                                  |        |        |        |        |         |           |           |          |                          |         |        |                |
|----------------------------------|--------|--------|--------|--------|---------|-----------|-----------|----------|--------------------------|---------|--------|----------------|
| Ext. temp.                       | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000   | 16.6000   | 16.4000  | 14.1000                  | 10.6000 | 7.1000 | 4.2000         |
| Heat loss rate W                 |        |        |        |        |         |           |           |          |                          |         |        |                |
| Utilisation                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1142.0221 | 899.0387  | 921.1789 | 0.0000                   | 0.0000  | 0.0000 | 0.0000 (100)   |
| Useful loss                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.8350    | 0.9087    | 0.8711   | 0.0000                   | 0.0000  | 0.0000 | 0.0000 (101)   |
| Total gains                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 953.6088  | 816.9877  | 802.4355 | 0.0000                   | 0.0000  | 0.0000 | 0.0000 (102)   |
| Space cooling kWh                | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1104.8559 | 1056.2434 | 970.9800 | 0.0000                   | 0.0000  | 0.0000 | 0.0000 (103)   |
| Cooled fraction                  | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 108.8979  | 178.0062  | 125.3971 | 0.0000                   | 0.0000  | 0.0000 | 0.0000 (104)   |
| Intermittency factor (Table 10b) |        |        |        |        |         |           |           |          | FC = cooled area / (4) = |         |        | 1.0000 (105)   |
| Space cooling kWh                | 0.2500 | 0.2500 | 0.2500 | 0.2500 | 0.2500  | 0.2500    | 0.2500    | 0.2500   | 0.2500                   | 0.2500  | 0.2500 | 0.2500 (106)   |
| Space cooling requirement        | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 27.2245   | 44.5015   | 31.3493  | 0.0000                   | 0.0000  | 0.0000 | 0.0000 (107)   |
| Energy for space heating         |        |        |        |        |         |           |           |          |                          |         |        | 103.0753 (107) |
| Energy for space cooling         |        |        |        |        |         |           |           |          |                          |         |        | 43.1147 (99)   |
| Total                            |        |        |        |        |         |           |           |          |                          |         |        | 0.9745 (108)   |
| Fabric Energy Efficiency (TFEE)  |        |        |        |        |         |           |           |          |                          |         |        | 44.0892 (109)  |
|                                  |        |        |        |        |         |           |           |          |                          |         |        | 44.1 (109)     |

# Full SAP Calculation Printout



|                                    |                        |               |               |                |                |            |
|------------------------------------|------------------------|---------------|---------------|----------------|----------------|------------|
| Property Reference                 | SAP VG 21-0282         |               |               |                | Issued on Date | 15/11/2024 |
| Assessment Reference               | Plot 54                |               | Prop Type Ref | SAP VG 21-0282 |                |            |
| Property                           |                        |               |               |                |                |            |
|                                    |                        |               |               |                |                |            |
| SAP Rating                         | 93 A                   | DER           | 12.81         | TER            | 12.86          |            |
| Environmental                      | 88 B                   | % DER < TER   |               |                |                | 0.39       |
| CO <sub>2</sub> Emissions (t/year) | 1.3                    | DFEE          | 41.49         | TFEE           | 44.09          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |               |                |                | 5.89       |
| % DPER < TPER                      | 0.23                   | DPER          | 67.36         | TPER           | 67.52          |            |
|                                    |                        |               |               |                |                |            |
| Assessor Details                   | Miss Victoria Gartside |               |               |                | Assessor ID    | AL30-0001  |
| Client                             |                        |               |               |                |                |            |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 25.4100 (1b)              | x 2.8400 (2b)                     | = 72.1644 (1b) - (3b)       |
| First floor                                            | 40.1800 (1c)              | x 2.3900 (2c)                     | = 96.0302 (1c) - (3c)       |
| Second floor                                           | 40.1800 (1d)              | x 2.6000 (2d)                     | = 104.4680 (1d) - (3d)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700                  |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 272.6626 (5)                |

## 2. Ventilation rate

|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of open chimneys                                                                            | 0 * 80 = 0.0000 (6a)                    |
| Number of open flues                                                                               | 0 * 20 = 0.0000 (6b)                    |
| Number of chimneys / flues attached to closed fire                                                 | 0 * 10 = 0.0000 (6c)                    |
| Number of flues attached to solid fuel boiler                                                      | 0 * 20 = 0.0000 (6d)                    |
| Number of flues attached to other heater                                                           | 0 * 35 = 0.0000 (6e)                    |
| Number of blocked chimneys                                                                         | 0 * 20 = 0.0000 (6f)                    |
| Number of intermittent extract fans                                                                | 6 * 10 = 60.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 60.0000 / (5) = 0.2201 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 4.0000 (17)                             |
| Infiltration rate                                                                                  | 0.4201 (18)                             |
| Number of sides sheltered                                                                          | 1 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3885 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4954 | 0.4857 | 0.4760 | 0.4274 | 0.4177 | 0.3691 | 0.3691 | 0.3594 | 0.3885 | 0.4177 | 0.4371 | 0.4565 (22b) |
| Effective ac    | 0.6227 | 0.6179 | 0.6133 | 0.5913 | 0.5872 | 0.5681 | 0.5681 | 0.5646 | 0.5755 | 0.5872 | 0.5955 | 0.6042 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K    |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|------------------|
| Solid front door                                               |                         |                            | 2.1400                    | 1.1000                        | 2.3540       |                                      | (26)             |
| Windows (Uw = 1.30)                                            |                         |                            | 15.6300                   | 1.2357                        | 19.3146      |                                      | (27)             |
| Ground floor                                                   |                         |                            | 25.4100                   | 0.1300                        | 3.3033       | 0.0000                               | 0.0000 (28a)     |
| Exposed floor                                                  |                         |                            | 14.7600                   | 0.2000                        | 2.9520       | 20.0000                              | 295.2000 (28b)   |
| Brick wall                                                     | 125.8800                | 17.7700                    | 108.1100                  | 0.1900                        | 20.5409      | 110.0000                             | 11892.1000 (29a) |
| Retaining wall                                                 | 12.9200                 |                            | 12.9200                   | 0.1800                        | 2.3256       | 110.0000                             | 1421.2000 (29a)  |
| Garage wall                                                    | 21.3200                 |                            | 21.3200                   | 0.1400                        | 2.9848       | 110.0000                             | 2345.2000 (29a)  |
| Plane roof                                                     | 40.1800                 |                            | 40.1800                   | 0.0900                        | 3.6162       | 9.0000                               | 361.6200 (30)    |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 240.4700                  |                               |              |                                      | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 57.3914      |                                      | (33)             |
| Party Wall 1                                                   |                         |                            | 69.1400                   | 0.0000                        | 0.0000       | 140.0000                             | 9679.6000 (32)   |
| Internal Wall                                                  |                         |                            | 18.2000                   |                               |              | 75.0000                              | 1365.0000 (32c)  |
| Internal Wall                                                  |                         |                            | 146.3400                  |                               |              | 9.0000                               | 1317.0600 (32c)  |
| Internal Floor 1                                               |                         |                            | 65.5900                   |                               |              | 18.0000                              | 1180.6200 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 65.5900                   |                               |              | 9.0000                               | 590.3100 (32e)   |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 30447.9100 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 287.8691 (35)    |

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## List of Thermal Bridges

|                                                                  | Length  | Psi-value             | Total        |
|------------------------------------------------------------------|---------|-----------------------|--------------|
| K1 Element                                                       | 12.3300 | 0.0240                | 0.2959       |
| E2 Other lintels (including other steel lintels)                 | 9.5000  | 0.0220                | 0.2090       |
| E3 Sill                                                          | 30.3000 | 0.0170                | 0.5151       |
| E4 Jamb                                                          | 20.1900 | 0.0920                | 1.8575       |
| E5 Ground floor (normal)                                         | 27.8700 | 0.0010                | 0.0279       |
| E6 Intermediate floor within a dwelling                          | 9.1000  | 0.0600                | 0.5460       |
| E10 Eaves (insulation at ceiling level)                          | 8.8500  | 0.0560                | 0.4956       |
| E12 Gable (insulation at ceiling level)                          | 18.5000 | 0.0460                | 0.8510       |
| E16 Corner (normal)                                              | 5.6800  | -0.0880               | -0.4998      |
| E17 Corner (inverted - internal area greater than external area) | 7.9900  | 0.0690                | 0.5513       |
| E20 Exposed floor (normal)                                       | 7.5100  | 0.3200                | 2.4032       |
| E21 Exposed floor (inverted)                                     | 15.6600 | 0.0380                | 0.5951       |
| E18 Party wall between dwellings                                 | 8.8300  | 0.0690                | 0.6093       |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0000                | 0.0000       |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000                | 0.0000       |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.4800                | 4.2384       |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)       |         |                       | 12.6954 (36) |
| Point Thermal bridges                                            |         |                       | 0.0000       |
| Total fabric heat loss                                           |         | (33) + (36) + (36a) = | 70.0868 (37) |

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (38)m                                                               | 56.0306  | 55.6019  | 55.1816  | 53.2077  | 52.8384  | 51.1191  | 51.1191  | 50.8008  | 51.7814  | 52.8384  | 53.5855  | 54.3666 (38)  |
| Heat transfer coeff                                                 | 126.1174 | 125.6887 | 125.2684 | 123.2945 | 122.9252 | 121.2060 | 121.2060 | 120.8876 | 121.8682 | 122.9252 | 123.6723 | 124.4534 (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 123.2927      |
| HLP                                                                 | 1.1924   | 1.1883   | 1.1843   | 1.1657   | 1.1622   | 1.1459   | 1.1459   | 1.1429   | 1.1522   | 1.1622   | 1.1693   | 1.1766 (40)   |
| HLP (average)                                                       |          |          |          |          |          |          |          |          |          |          |          | 1.1657        |
| Days in mont                                                        | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31            |

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

|                                                                                |          |          |          |          |          |          |          |          |          |                                        |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------|----------|----------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |                                        |          | 2.7869 (42)    |
| Hot water usage for mixer showers                                              | 70.9471  | 69.8809  | 68.3272  | 65.3546  | 63.1608  | 60.7144  | 59.3238  | 60.8657  | 62.5559  | 65.1827                                | 68.2192  | 70.6752 (42a)  |
| Hot water usage for baths                                                      | 30.6328  | 30.1778  | 29.5372  | 28.3559  | 27.4714  | 26.4907  | 25.9609  | 26.5971  | 27.2897  | 28.3392                                | 29.5448  | 30.5292 (42b)  |
| Hot water usage for other uses                                                 | 43.1707  | 41.6009  | 40.0310  | 38.4612  | 36.8913  | 35.3215  | 35.3215  | 36.8913  | 38.4612  | 40.0310                                | 41.6009  | 43.1707 (42c)  |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |                                        |          | 133.0583 (43)  |
| Daily hot water use                                                            | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541 | 128.3069 | 133.5529                               | 139.3648 | 144.3752 (44)  |
| Energy conte                                                                   | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764 | 158.2152 | 181.2300                               | 198.5507 | 226.0566 (45)  |
| Energy content (annual)                                                        |          |          |          |          |          |          |          |          |          | Total = Sum(45)m =                     |          | 2210.0711      |
| Distribution loss (46)m = 0.15 x (45)m                                         | 34.3874  | 30.2582  | 31.7910  | 27.1405  | 25.7507  | 22.5991  | 21.8794  | 23.0965  | 23.7323  | 27.1845                                | 29.7826  | 33.9085 (46)   |
| Water storage loss:                                                            |          |          |          |          |          |          |          |          |          |                                        |          |                |
| Total storage loss                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                                   |          |          |          |          |          |          |          |          |          |                                        |          |                |
| Primary loss                                                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (57)    |
| Combi loss                                                                     | 2.5528   | 2.3647   | 2.6361   | 2.4472   | 2.4735   | 2.3138   | 2.2934   | 2.3113   | 2.2561   | 2.4036                                 | 2.4141   | 2.5334 (61)    |
| Total heat required for water heating calculated for each month                | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337                               | 200.9648 | 228.5900 (62)  |
| WWHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (63a)   |
| PV diverter                                                                    | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000                                | -0.0000  | -0.0000 (63b)  |
| Solar input                                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (63c)   |
| FGHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (63d)   |
| Output from w/h                                                                | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337                               | 200.9648 | 228.5900 (64)  |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m = |          | 2239.0711 (64) |
| Electric shower(s)                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (64a)   |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |                                        |          | 0.0000 (64a)   |
| Heat gains from water heating, kWh/month                                       | 76.8636  | 67.6635  | 71.1291  | 60.7732  | 57.6991  | 50.6731  | 49.0727  | 51.7750  | 53.1706  | 60.8599                                | 66.6216  | 75.7972 (65)   |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 141.9174  | 157.1228  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.3326  | 268.0859  | 261.1477  | 246.3769  | 227.7314  | 210.2073  | 198.5001  | 195.7468  | 202.6851  | 217.4559  | 236.1013  | 253.6254 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 (71) |
| Water heating gains (Table 5)                                                       | 103.3114  | 100.6898  | 95.6036   | 84.4072   | 77.5525   | 70.3794   | 65.9580   | 69.5900   | 73.8480   | 81.8009   | 92.5301   | 101.8779 (72)  |
| Total internal gains                                                                | 578.3650  | 593.7021  | 566.4723  | 545.2356  | 515.0049  | 492.0382  | 471.1791  | 472.0578  | 487.9847  | 508.9778  | 543.0830  | 565.2243 (73)  |

## 6. Solar gains

| [Jan] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| North | 1.4200     | 10.6334                        | 0.7300                            | 0.7000                             | 0.7700                       | 5.3471 (74)  |
| East  | 7.2100     | 19.6403                        | 0.7300                            | 0.7000                             | 0.7700                       | 50.1460 (76) |

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|                                                                                                      |           |           |           |           |           |           |           |           |           |                           |              |                 |
|------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------------------|--------------|-----------------|
| West                                                                                                 | 7.0000    |           | 19.6403   |           | 0.7300    |           | 0.7000    |           | 0.7700    |                           | 48.6855 (80) |                 |
| Solar gains                                                                                          | 104.1786  | 203.5539  | 335.7596  | 492.2521  | 606.6636  | 622.7884  | 592.1794  | 506.2095  | 391.1845  | 241.5726                  | 129.8276     | 85.7318 (83)    |
| Total gains                                                                                          | 682.5436  | 797.2561  | 902.2319  | 1037.4877 | 1121.6685 | 1114.8266 | 1063.3584 | 978.2673  | 879.1691  | 750.5504                  | 672.9105     | 650.9561 (84)   |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| 7. Mean internal temperature (heating season)                                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Temperature during heating periods in the living area from Table 9, Th1 (C)                          |           |           |           |           |           |           |           |           |           |                           |              | 21.0000 (85)    |
| Utilisation factor for gains for living area, nil,m (see Table 9a)                                   |           |           |           |           |           |           |           |           |           |                           |              |                 |
|                                                                                                      | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct                       | Nov          | Dec             |
| tau                                                                                                  | 67.0625   | 67.2913   | 67.5170   | 68.5980   | 68.8041   | 69.7800   | 69.7800   | 69.9638   | 69.4008   | 68.8041                   | 68.3884      | 67.9592         |
| alpha                                                                                                | 5.4708    | 5.4861    | 5.5011    | 5.5732    | 5.5869    | 5.6520    | 5.6520    | 5.6643    | 5.6267    | 5.5869                    | 5.5592       | 5.5306          |
| util living area                                                                                     | 0.9986    | 0.9963    | 0.9892    | 0.9557    | 0.8561    | 0.6659    | 0.4964    | 0.5582    | 0.8296    | 0.9783                    | 0.9967       | 0.9989 (86)     |
| MIT                                                                                                  | 20.5098   | 20.5540   | 20.6230   | 20.7201   | 20.7921   | 20.8278   | 20.8341   | 20.8334   | 20.8094   | 20.7105                   | 20.5961      | 20.5072 (87)    |
| Th 2                                                                                                 | 19.9261   | 19.9294   | 19.9325   | 19.9476   | 19.9504   | 19.9635   | 19.9635   | 19.9659   | 19.9584   | 19.9504                   | 19.9447      | 19.9387 (88)    |
| util rest of house                                                                                   | 0.9980    | 0.9949    | 0.9847    | 0.9372    | 0.8024    | 0.5713    | 0.3823    | 0.4383    | 0.7489    | 0.9659                    | 0.9951       | 0.9985 (89)     |
| MIT 2                                                                                                | 19.3360   | 19.3955   | 19.4862   | 19.6204   | 19.7036   | 19.7484   | 19.7519   | 19.7544   | 19.7301   | 19.6136                   | 19.4639      | 19.3445 (90)    |
| Living area fraction                                                                                 | 19.5329   | 19.5898   | 19.6769   | 19.8049   | 19.8861   | 19.9294   | 19.9334   | 19.9354   | 19.9111   | fLA = Living area / (4) = | 19.6538      | 0.1677 (91)     |
| MIT                                                                                                  | 19.5329   | 19.5898   | 19.6769   | 19.8049   | 19.8861   | 19.9294   | 19.9334   | 19.9354   | 19.9111   | 19.7976                   | 19.6538      | 19.5395 (92)    |
| Temperature adjustment                                                                               | 19.3829   | 19.4398   | 19.5269   | 19.6549   | 19.7361   | 19.7794   | 19.7834   | 19.7854   | 19.7611   | 19.6476                   | 19.5038      | -0.1500         |
| adjusted MIT                                                                                         | 19.3829   | 19.4398   | 19.5269   | 19.6549   | 19.7361   | 19.7794   | 19.7834   | 19.7854   | 19.7611   | 19.6476                   | 19.5038      | 19.3895 (93)    |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| 8. Space heating requirement                                                                         |           |           |           |           |           |           |           |           |           |                           |              |                 |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
|                                                                                                      | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct                       | Nov          | Dec             |
| Utilisation                                                                                          | 0.9976    | 0.9940    | 0.9825    | 0.9308    | 0.7896    | 0.5533    | 0.3621    | 0.4166    | 0.7307    | 0.9609                    | 0.9942       | 0.9982 (94)     |
| Useful gains                                                                                         | 680.9349  | 792.4887  | 886.4099  | 965.6680  | 885.6172  | 616.8553  | 385.0460  | 407.5355  | 642.4142  | 721.2347                  | 669.0232     | 649.7813 (95)   |
| Ext temp.                                                                                            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000   | 16.6000   | 16.4000   | 14.1000   | 10.6000                   | 7.1000       | 4.2000 (96)     |
| Heat loss rate W                                                                                     | 1902.2173 | 1827.4927 | 1631.8533 | 1326.0167 | 987.8438  | 627.7740  | 385.8454  | 409.2504  | 689.9064  | 1112.1793                 | 1534.0087    | 1890.3849 (97)  |
| Space heating kWh                                                                                    | 908.6341  | 695.5227  | 554.6099  | 259.4510  | 76.0566   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 290.8628                  | 622.7895     | 923.0091 (98a)  |
| Space heating requirement - total per year (kWh/year)                                                |           |           |           |           |           |           |           |           |           |                           |              | 4330.9357       |
| Solar heating kWh                                                                                    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (98b)    |
| Solar heating contribution - total per year (kWh/year)                                               |           |           |           |           |           |           |           |           |           |                           |              | 0.0000          |
| Space heating kWh                                                                                    | 908.6341  | 695.5227  | 554.6099  | 259.4510  | 76.0566   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 290.8628                  | 622.7895     | 923.0091 (98c)  |
| Space heating requirement after solar contribution - total per year (kWh/year)                       |           |           |           |           |           |           |           |           |           |                           |              | 4330.9357       |
| Space heating per m2                                                                                 |           |           |           |           |           |           |           |           |           | (98c) / (4) =             |              | 40.9467 (99)    |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| 9a. Energy requirements - Individual heating systems, including micro-CHP                            |           |           |           |           |           |           |           |           |           |                           |              |                 |
| -----                                                                                                |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Fraction of space heat from secondary/supplementary system (Table 11)                                |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (201)    |
| Fraction of space heat from main system(s)                                                           |           |           |           |           |           |           |           |           |           |                           |              | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                                                     |           |           |           |           |           |           |           |           |           |                           |              | 88.6000 (206)   |
| Efficiency of main space heating system 2 (in %)                                                     |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %                                              |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (208)    |
|                                                                                                      | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct                       | Nov          | Dec             |
| Space heating requirement                                                                            | 908.6341  | 695.5227  | 554.6099  | 259.4510  | 76.0566   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 290.8628                  | 622.7895     | 923.0091 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 88.6000   | 88.6000   | 88.6000   | 88.6000   | 88.6000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 88.6000                   | 88.6000      | 88.6000 (210)   |
| Space heating fuel (main heating system)                                                             | 1025.5464 | 785.0143  | 625.9706  | 292.8341  | 85.8426   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 328.2875                  | 702.9227     | 1041.7710 (211) |
| Space heating efficiency (main heating system 2)                                                     | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (212)    |
| Space heating fuel (main heating system 2)                                                           | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (213)    |
| Space heating fuel (secondary)                                                                       | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (215)    |
| Water heating                                                                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Water heating requirement                                                                            | 231.8023  | 204.0860  | 214.5762  | 183.3837  | 174.1448  | 152.9745  | 148.1562  | 156.2877  | 160.4713  | 183.6337                  | 200.9648     | 228.5900 (64)   |
| Efficiency of water heater (217)m                                                                    | 86.6096   | 86.3842   | 85.8909   | 84.6371   | 82.1362   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 84.8856                   | 86.2217      | 79.6000 (216)   |
| Fuel for water heating, kWh/month                                                                    | 267.6404  | 236.2538  | 249.8242  | 216.6705  | 212.0194  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 216.3306                  | 233.0792     | 86.6552 (217)   |
| Space cooling fuel requirement                                                                       |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (221)m                                                                                               | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (221)    |
| Pumps and Fa                                                                                         | 7.3041    | 6.5973    | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041                    | 7.0685       | 7.3041 (231)    |
| Lighting                                                                                             | 28.8849   | 23.1726   | 20.8643   | 15.2861   | 11.8074   | 9.6468    | 10.7711   | 14.0007   | 18.1855   | 23.8604                   | 26.9503      | 29.6877 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (233a)m                                                                                              | -33.0601  | -51.3704  | -81.6378  | -98.5308  | -109.6129 | -103.2046 | -101.4318 | -93.7910  | -79.9001  | -61.4567                  | -37.5969     | -27.7837 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (234a)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (234a)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235a)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235a)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235c)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235c)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (233b)m                                                                                              | -14.9249  | -36.2530  | -85.9866  | -150.0681 | -216.2967 | -224.4244 | -218.8576 | -173.8982 | -112.6673 | -55.7180                  | -20.8495     | -11.3176 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (234b)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235b)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235b)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |           |           |           |           |           |           |           |           |           |                           |              |                 |
| (235d)m                                                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000                    | 0.0000       | 0.0000 (235d)   |
| Annual totals kWh/year                                                                               |           |           |           |           |           |           |           |           |           |                           |              |                 |
| Space heating fuel - main system 1                                                                   |           |           |           |           |           |           |           |           |           |                           |              | 4888.1893 (211) |
| Space heating fuel - main system 2                                                                   |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (215)    |
| Efficiency of water heater                                                                           |           |           |           |           |           |           |           |           |           |                           |              | 79.6000         |
| Water heating fuel used                                                                              |           |           |           |           |           |           |           |           |           |                           |              | 2671.8541 (219) |
| Space cooling fuel                                                                                   |           |           |           |           |           |           |           |           |           |                           |              | 0.0000 (221)    |

# Full SAP Calculation Printout



|                                                               |                  |
|---------------------------------------------------------------|------------------|
| Electricity for pumps and fans:                               |                  |
| central heating pump                                          | 41.0000 (230c)   |
| main heating flue fan                                         | 45.0000 (230e)   |
| Total electricity for the above, kWh/year                     | 86.0000 (231)    |
| Electricity for lighting (calculated in Appendix L)           | 233.1179 (232)   |
| Energy saving/generation technologies (Appendices M ,N and Q) |                  |
| PV generation                                                 | -2200.6387 (233) |
| Wind generation                                               | 0.0000 (234)     |
| Hydro-electric generation (Appendix N)                        | 0.0000 (235a)    |
| Electricity generated - Micro CHP (Appendix N)                | 0.0000 (235)     |
| Appendix Q - special features                                 |                  |
| Energy saved or generated                                     | -0.0000 (236)    |
| Energy used                                                   | 0.0000 (237)     |
| Total delivered energy for all uses                           | 5678.5225 (238)  |

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

|                                                 | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                   | 4888.1893          | 0.2100                        | 1026.5197 (261)          |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                      | 2671.8541          | 0.2100                        | 561.0894 (264)           |
| Space and water heating                         |                    |                               | 1587.6091 (265)          |
| Pumps, fans and electric keep-hot               | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                             | 233.1179           | 0.1443                        | 33.6461 (268)            |
| Energy saving/generation technologies           |                    |                               |                          |
| PV Unit electricity used in dwelling            | -879.3767          | 0.1332                        | -117.1173                |
| PV Unit electricity exported                    | -1321.2619         | 0.1223                        | -161.6557                |
| Total                                           |                    |                               | -278.7731 (269)          |
| Total CO2, kg/year                              |                    |                               | 1354.4114 (272)          |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 12.8100 (273)            |

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

|                                             | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1               | 4888.1893          | 1.1300                              | 5523.6539 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2671.8541          | 1.1300                              | 3019.1951 (278)            |
| Space and water heating                     |                    |                                     | 8542.8489 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 233.1179           | 1.5338                              | 357.5639 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -879.3767          | 1.4921                              | -1312.1603                 |
| PV Unit electricity exported                | -1321.2619         | 0.4489                              | -593.1622                  |
| Total                                       |                    |                                     | -1905.3225 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 7125.1912 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 67.3600 (287)              |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF TARGET EMISSIONS

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)              | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|-----------------------------------|-----------------------------|
| Ground floor                                           | 25.4100 (1b)              | x 2.8400 (2b)                     | = 72.1644 (1b) - (3b)       |
| First floor                                            | 40.1800 (1c)              | x 2.3900 (2c)                     | = 96.0302 (1c) - (3c)       |
| Second floor                                           | 40.1800 (1d)              | x 2.6000 (2d)                     | = 104.4680 (1d) - (3d)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700                  |                                   | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 272.6626 (5)                |

## 2. Ventilation rate

|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of open chimneys                                                                            | 0 * 80 = 0.0000 (6a)                    |
| Number of open flues                                                                               | 0 * 20 = 0.0000 (6b)                    |
| Number of chimneys / flues attached to closed fire                                                 | 0 * 10 = 0.0000 (6c)                    |
| Number of flues attached to solid fuel boiler                                                      | 0 * 20 = 0.0000 (6d)                    |
| Number of flues attached to other heater                                                           | 0 * 35 = 0.0000 (6e)                    |
| Number of blocked chimneys                                                                         | 0 * 20 = 0.0000 (6f)                    |
| Number of intermittent extract fans                                                                | 4 * 10 = 40.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) = 0.1467 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0000 (17)                             |
| Infiltration rate                                                                                  | 0.3967 (18)                             |
| Number of sides sheltered                                                                          | 1 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3669 (21)        |

# Full SAP Calculation Printout



|                 |               |               |               |               |               |               |               |               |               |               |               |                    |
|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------------|
| Wind speed      | Jan<br>5.1000 | Feb<br>5.0000 | Mar<br>4.9000 | Apr<br>4.4000 | May<br>4.3000 | Jun<br>3.8000 | Jul<br>3.8000 | Aug<br>3.7000 | Sep<br>4.0000 | Oct<br>4.3000 | Nov<br>4.5000 | Dec<br>4.7000 (22) |
| Wind factor     | 1.2750        | 1.2500        | 1.2250        | 1.1000        | 1.0750        | 0.9500        | 0.9500        | 0.9250        | 1.0000        | 1.0750        | 1.1250        | 1.1750 (22a)       |
| Adj infilt rate |               |               |               |               |               |               |               |               |               |               |               |                    |
| Effective ac    | 0.4679        | 0.4587        | 0.4495        | 0.4036        | 0.3945        | 0.3486        | 0.3486        | 0.3394        | 0.3669        | 0.3945        | 0.4128        | 0.4312 (22b)       |
|                 | 0.6094        | 0.6052        | 0.6010        | 0.5815        | 0.5778        | 0.5608        | 0.5608        | 0.5576        | 0.5673        | 0.5778        | 0.5852        | 0.5930 (25)        |

## 3. Heat losses and heat loss parameter

| Element                                        | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |
|------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|-------------------|---------------|
| TER Opaque door                                |             |                | 2.1400        | 1.0000               | 2.1400       |                   | (26)          |
| TER Opening Type (Uw = 1.20)                   |             |                | 15.6300       | 1.1450               | 17.8969      |                   | (27)          |
| Ground floor                                   |             |                | 25.4100       | 0.1300               | 3.3033       |                   | (28a)         |
| Exposed floor                                  |             |                | 14.7600       | 0.1300               | 1.9188       |                   | (28b)         |
| Brick wall                                     | 125.8800    | 17.7700        | 108.1100      | 0.1800               | 19.4598      |                   | (29a)         |
| Retaining wall                                 | 12.9200     |                | 12.9200       | 0.1800               | 2.3256       |                   | (29a)         |
| Garage wall                                    | 21.3200     |                | 21.3200       | 0.1800               | 3.8376       |                   | (29a)         |
| Plane roof                                     | 40.1800     |                | 40.1800       | 0.1100               | 4.4198       |                   | (30)          |
| Total net area of external elements Aum(A, m2) |             |                | 240.4700      |                      |              |                   | (31)          |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               | (26)...(30) + (32) = | 55.3018      |                   | (33)          |
| Party Wall 1                                   |             |                | 69.1400       | 0.0000               | 0.0000       |                   | (32)          |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K

287.8691 (35)

List of Thermal Bridges

| K1 Element                                                       | Length  | Psi-value | Total   |
|------------------------------------------------------------------|---------|-----------|---------|
| E2 Other lintels (including other steel lintels)                 | 12.3300 | 0.0500    | 0.6165  |
| E3 Sill                                                          | 9.5000  | 0.0500    | 0.4750  |
| E4 Jamb                                                          | 30.3000 | 0.0500    | 1.5150  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.1600    | 3.2304  |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0000    | 0.0000  |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460  |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0600    | 0.5310  |
| E16 Corner (normal)                                              | 18.5000 | 0.0900    | 1.6650  |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0900   | -0.5112 |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.3200    | 2.5568  |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032  |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0600    | 0.9396  |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0800    | 0.7064  |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000    | 0.0000  |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.1200    | 1.0596  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K)

15.7333 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 71.0351 (37)

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

|                           |                |                |                |                |                |                |                |                |                |                |                |                     |
|---------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| (38)m                     | Jan<br>54.8372 | Feb<br>54.4548 | Mar<br>54.0799 | Apr<br>52.3194 | May<br>51.9900 | Jun<br>50.4566 | Jul<br>50.4566 | Aug<br>50.1726 | Sep<br>51.0472 | Oct<br>51.9900 | Nov<br>52.6563 | Dec<br>53.3530 (38) |
| Heat transfer coeff       | 125.8723       | 125.4899       | 125.1151       | 123.3545       | 123.0251       | 121.4917       | 121.4917       | 121.2077       | 122.0824       | 123.0251       | 123.6915       | 124.3881 (39)       |
| Average = Sum(39)m / 12 = |                |                |                |                |                |                |                |                |                |                |                | 123.3529            |

|               |               |               |               |               |               |               |               |               |               |               |               |                    |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------------------|
| HLP           | Jan<br>1.1901 | Feb<br>1.1864 | Mar<br>1.1829 | Apr<br>1.1663 | May<br>1.1631 | Jun<br>1.1486 | Jul<br>1.1486 | Aug<br>1.1460 | Sep<br>1.1542 | Oct<br>1.1631 | Nov<br>1.1694 | Dec<br>1.1760 (40) |
| HLP (average) |               |               |               |               |               |               |               |               |               |               |               | 1.1662             |
| Days in mont  | 31            | 28            | 31            | 30            | 31            | 30            | 31            | 31            | 30            | 31            | 30            | 31                 |

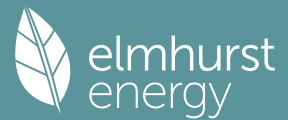
## 4. Water heating energy requirements (kWh/year)

|                                          |         |         |         |         |         |         |         |         |         |         |               |               |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------|---------------|
| Assumed occupancy                        |         |         |         |         |         |         |         |         |         |         |               | 2.7869 (42)   |
| Hot water usage for mixer showers        |         |         |         |         |         |         |         |         |         |         |               |               |
| 70.9471                                  | 69.8809 | 68.3272 | 65.3546 | 63.1608 | 60.7144 | 59.3238 | 60.8657 | 62.5559 | 65.1827 | 68.2192 | 70.6752 (42a) |               |
| Hot water usage for baths                |         |         |         |         |         |         |         |         |         |         |               |               |
| 30.6328                                  | 30.1778 | 29.5372 | 28.3559 | 27.4714 | 26.4907 | 25.9609 | 26.5971 | 27.2897 | 28.3392 | 29.5448 | 30.5292 (42b) |               |
| Hot water usage for other uses           |         |         |         |         |         |         |         |         |         |         |               |               |
| 43.1707                                  | 41.6009 | 40.0310 | 38.4612 | 36.8913 | 35.3215 | 35.3215 | 36.8913 | 38.4612 | 40.0310 | 41.6009 | 43.1707 (42c) |               |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |               | 133.0583 (43) |

|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug                                    | Sep      | Oct      | Nov      | Dec            |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------|----------|----------|----------|----------------|
| Daily hot water use                                                            | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541                               | 128.3069 | 133.5529 | 139.3648 | 144.3752 (44)  |
| Energy content (annual)                                                        | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764                               | 158.2152 | 181.2300 | 198.5507 | 226.0566 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                                         | 34.3874  | 30.2582  | 31.7910  | 27.1405  | 25.7507  | 22.5991  | 21.8794  | 23.0965                                | 23.7323  | 27.1845  | 29.7826  | 33.9085 (46)   |
| Water storage loss:                                                            |          |          |          |          |          |          |          |                                        |          |          |          |                |
| Total storage loss                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000 (56)    |
| If cylinder contains dedicated solar storage                                   |          |          |          |          |          |          |          |                                        |          |          |          |                |
|                                                                                | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)    |
| Primary loss                                                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000 (59)    |
| Combi loss                                                                     | 50.9589  | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589                                | 49.3151  | 50.9589  | 49.3151  | 50.9589 (61)   |
| Total heat required for water heating calculated for each month                |          |          |          |          |          |          |          |                                        |          |          |          |                |
|                                                                                | 280.2084 | 247.7487 | 262.8990 | 230.2515 | 222.6302 | 199.9758 | 196.8217 | 204.9353                               | 207.5303 | 232.1889 | 247.8658 | 277.0155 (62)  |
| WWHRS                                                                          | -32.4340 | -28.6849 | -30.0372 | -24.8720 | -23.1798 | -19.8351 | -18.5923 | -19.7710                               | -20.5222 | -24.1934 | -27.4082 | -31.8334 (63a) |
| PV diverter                                                                    | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000                                | -0.0000  | -0.0000  | -0.0000  | -0.0000 (63b)  |
| Solar input                                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63c)   |
| FGHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63d)   |
| Output from w/h                                                                | 247.7744 | 219.0638 | 232.8618 | 205.3795 | 199.4504 | 180.1406 | 178.2294 | 185.1643                               | 187.0081 | 207.9955 | 220.4576 | 245.1821 (64)  |
|                                                                                |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m = |          |          |          | 2508.7076 (64) |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |                                        |          |          |          | 2509 (64)      |
| Electric shower(s)                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000 (64a)   |
|                                                                                |          |          |          |          |          |          |          |                                        |          |          |          | 0.0000 (64a)   |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |                                        |          |          |          |                |
| Heat gains from water heating, kWh/month                                       | 88.9652  | 78.5792  | 83.2098  | 72.4901  | 69.8204  | 62.4234  | 61.2391  | 63.9369                                | 64.9353  | 72.9987  | 78.3469  | 87.9035 (65)   |

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

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| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| (66)m                                                                               | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | 139.3453  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 141.9174  | 157.1228  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | 141.9174  | 146.6480  | 141.9174  | 146.6480  | 141.9174  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 265.3326  | 268.0859  | 261.1477  | 246.3769  | 227.7314  | 210.2073  | 198.5001  | 195.7468  | 202.6851  | 217.4559  | 236.1013  | 253.6254  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | 36.9345   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | (71) |
| Water heating gains (Table 5)                                                       | 119.5769  | 116.9333  | 111.8411  | 100.6807  | 93.8447   | 86.6992   | 82.3106   | 85.9367   | 90.1879   | 98.1165   | 108.8151  | 118.1499  | (72) |
| Total internal gains                                                                | 594.6305  | 609.9457  | 582.7098  | 561.5092  | 531.2971  | 508.3581  | 487.5317  | 488.4045  | 504.3246  | 525.2934  | 559.3680  | 581.4964  | (73) |

## 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| North       |          |          |          | 1.4200     | 10.6334                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 4.6146 (74)  |               |
| East        |          |          |          | 7.2100     | 19.6403                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 43.2767 (76) |               |
| West        |          |          |          | 7.0000     | 19.6403                        |           | 0.6300                            | 0.7000                             | 0.7700                       |          | 42.0162 (80) |               |
|             |          |          |          |            |                                |           |                                   |                                    |                              |          |              |               |
| Solar gains | 89.9075  | 175.6698 | 289.7652 | 424.8203   | 523.5590                       | 537.4749  | 511.0589                          | 436.8657                           | 337.5975                     | 208.4804 | 112.0430     | 73.9877 (83)  |
| Total gains | 684.5380 | 785.6155 | 872.4750 | 986.3295   | 1054.8561                      | 1045.8330 | 998.5907                          | 925.2702                           | 841.9222                     | 733.7738 | 671.4110     | 655.4841 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |         |              |
| Jan                                                                         | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec     |         |              |
| tau                                                                         | 67.1931 | 67.3979 | 67.5998 | 68.5646 | 68.7482 | 69.6159 | 69.6159 | 69.7790 | 69.2791                   | 68.7482 | 68.3778 | 67.9949 |              |
| alpha                                                                       | 5.4795  | 5.4932  | 5.5067  | 5.5710  | 5.5832  | 5.6411  | 5.6411  | 5.6519  | 5.6186                    | 5.5832  | 5.5585  | 5.5330  |              |
| util living area                                                            | 0.9986  | 0.9966  | 0.9907  | 0.9639  | 0.8803  | 0.7018  | 0.5279  | 0.5884  | 0.8491                    | 0.9804  | 0.9967  | 0.9989  | (86)         |
| MIT                                                                         | 19.7244 | 19.8866 | 20.1449 | 20.5108 | 20.8053 | 20.9606 | 20.9933 | 20.9881 | 20.8847                   | 20.4941 | 20.0525 | 19.7067 | (87)         |
| Th 2                                                                        | 19.9280 | 19.9309 | 19.9337 | 19.9471 | 19.9496 | 19.9613 | 19.9613 | 19.9635 | 19.9568                   | 19.9496 | 19.9445 | 19.9392 | (88)         |
| util rest of house                                                          | 0.9980  | 0.9952  | 0.9868  | 0.9482  | 0.8313  | 0.6058  | 0.4074  | 0.4634  | 0.7719                    | 0.9690  | 0.9952  | 0.9984  | (89)         |
| MIT 2                                                                       | 18.4464 | 18.6558 | 18.9867 | 19.4519 | 19.7896 | 19.9407 | 19.9595 | 19.9598 | 19.8812                   | 19.4405 | 18.8787 | 18.4319 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1677  | (91)         |
| MIT                                                                         | 18.6607 | 18.8622 | 19.1809 | 19.6295 | 19.9600 | 20.1117 | 20.1329 | 20.1323 | 20.0495                   | 19.6173 | 19.0756 | 18.6457 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.6607 | 18.8622 | 19.1809 | 19.6295 | 19.9600 | 20.1117 | 20.1329 | 20.1323 | 20.0495                   | 19.6173 | 19.0756 | 18.6457 | (93)         |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |               |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|-----------|-----------|-------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec       |       |
|                                                                                | 0.9970    | 0.9932    | 0.9829    | 0.9421    | 0.8318    | 0.6206   | 0.4277   | 0.4845   | 0.7799   | 0.9639        | 0.9932    | 0.9976    | (94)  |
| Useful gains                                                                   | 682.4548  | 780.2986  | 857.5849  | 929.2300  | 877.4495  | 649.0893 | 427.1187 | 448.2988 | 656.6000 | 707.3172      | 666.8714  | 653.9106  | (95)  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000   | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000       | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W                                                               | 1807.6200 | 1752.1193 | 1586.5739 | 1323.5342 | 1016.1837 | 669.6302 | 429.2159 | 452.3851 | 726.3317 | 1109.3493     | 1481.2777 | 1796.8759 | (97)  |
| Space heating kWh                                                              | 837.1229  | 653.0635  | 542.3678  | 283.8990  | 103.2183  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 299.1118      | 586.3725  | 850.3662  | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |               |           | 4155.5221 |       |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000    | 0.0000    | (98b) |
| Solar heating contribution - total per year (kWh/year)                         |           |           |           |           |           |          |          |          |          |               |           | 0.0000    |       |
| Space heating kWh                                                              | 837.1229  | 653.0635  | 542.3678  | 283.8990  | 103.2183  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 299.1118      | 586.3725  | 850.3662  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |               |           | 4155.5221 |       |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          | (98c) / (4) = |           | 39.2883   | (99)  |

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

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)  |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)  |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 92.4000 (206) |
| Efficiency of main space heating system 2 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (207)  |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)  |
| Jan                                                                   | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |          |               |
| Space heating requirement                                             | 837.1229 | 653.0635 | 542.3678 | 283.8990 | 103.2183 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 299.1118 | 586.3725 | 850.3662 | (98)          |
| Space heating efficiency (main heating system 1)                      | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 92.4000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 92.4000  | 92.4000  | 92.4000  | (210)         |
| Space heating fuel (main heating system)                              | 905.9772 | 706.7787 | 586.9781 | 307.2499 | 111.7081 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 323.7141 | 634.6023 | 920.3098 | (211)         |
| Space heating efficiency (main heating system 2)                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (212)         |
| Space heating fuel (main heating system 2)                            | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (213)         |
| Space heating fuel (secondary)                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215)         |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |          |               |
| Water heating requirement                                             | 247.7744 | 219.0638 | 232.8618 | 205.3795 | 199.4504 | 180.1406 | 178.2294 | 185.1643 | 187.0081 | 207.9955 | 220.4576 | 245.1821 | (64)          |
| Efficiency of water heater                                            | 86.7775  | 86.5711  | 86.1292  | 85.0754  | 83.0395  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 85.1592  | 86.3724  | 86.8191  | (216)         |
| Fuel for water heating, kWh/month                                     |          |          |          |          |          |          |          |          |          |          |          |          | (217)         |

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|                                                                                                      |          |          |          |           |           |           |           |           |           |          |          |            |        |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------|--------|
|                                                                                                      | 285.5285 | 253.0449 | 270.3633 | 241.4088  | 240.1874  | 224.3345  | 221.9545  | 230.5907  | 232.8868  | 244.2433 | 255.2407 | 282.4058   | (219)  |
| Space cooling fuel requirement                                                                       |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (221)m                                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (221)  |
| Pumps and Fa                                                                                         | 7.3041   | 6.5973   | 7.3041   | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041   | 7.0685   | 7.3041     | (231)  |
| Lighting                                                                                             | 29.4876  | 23.6561  | 21.2997  | 15.6051   | 12.0538   | 9.8481    | 10.9959   | 14.2929   | 18.5650   | 24.3583  | 27.5126  | 30.3072    | (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (233a)m                                                                                              | -38.9155 | -55.5613 | -80.8490 | -92.0318  | -100.1559 | -93.7669  | -92.5734  | -86.9330  | -77.1467  | -64.0142 | -43.0168 | -33.5605   | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (234a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235c)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (233b)m                                                                                              | -19.9013 | -42.0938 | -84.1047 | -126.9762 | -168.5551 | -169.6411 | -167.6836 | -141.7059 | -103.4811 | -60.4596 | -26.6523 | -15.7233   | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (234b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (235d)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235d) |
| Annual totals kWh/year                                                                               |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Space heating fuel - main system 1                                                                   |          |          |          |           |           |           |           |           |           |          |          | 4497.3183  | (211)  |
| Space heating fuel - main system 2                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (213)  |
| Space heating fuel - secondary                                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (215)  |
| Efficiency of water heater                                                                           |          |          |          |           |           |           |           |           |           |          |          | 80.3000    |        |
| Water heating fuel used                                                                              |          |          |          |           |           |           |           |           |           |          |          | 2982.1891  | (219)  |
| Space cooling fuel                                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (221)  |
| Electricity for pumps and fans:                                                                      |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Total electricity for the above, kWh/year                                                            |          |          |          |           |           |           |           |           |           |          |          | 86.0000    | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                  |          |          |          |           |           |           |           |           |           |          |          | 237.9821   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| PV generation                                                                                        |          |          |          |           |           |           |           |           |           |          |          | -1985.5029 | (233)  |
| Wind generation                                                                                      |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (234)  |
| Hydro-electric generation (Appendix N)                                                               |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (235a) |
| Electricity generated - Micro CHP (Appendix N)                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (235)  |
| Appendix Q - special features                                                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Energy saved or generated                                                                            |          |          |          |           |           |           |           |           |           |          |          | -0.0000    | (236)  |
| Energy used                                                                                          |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (237)  |
| Total delivered energy for all uses                                                                  |          |          |          |           |           |           |           |           |           |          |          | 5817.9866  | (238)  |

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

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 4497.3183          | 0.2100                        | 944.4368 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2982.1891          | 0.2100                        | 626.2597 (264)           |
| Space and water heating                       |                    |                               | 1570.6965 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 237.9821           | 0.1443                        | 34.3482 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -858.5249          | 0.1343                        | -115.3320                |
| PV Unit electricity exported                  | -1126.9779         | 0.1257                        | -141.7033                |
| Total                                         |                    |                               | -257.0353 (269)          |
| Total CO2, kg/year                            |                    |                               | 1359.9387 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 12.8600 (273)            |

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

|                                             | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1               | 4497.3183          | 1.1300                              | 5081.9696 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2982.1891          | 1.1300                              | 3369.8737 (278)            |
| Space and water heating                     |                    |                                     | 8451.8433 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 237.9821           | 1.5338                              | 365.0249 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -858.5249          | 1.4965                              | -1284.7605                 |
| PV Unit electricity exported                | -1126.9779         | 0.4615                              | -520.1396                  |
| Total                                       |                    |                                     | -1804.9001 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 7142.0689 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 67.5200 (287)              |

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|                                    |                        |  |               |                |                |            |
|------------------------------------|------------------------|--|---------------|----------------|----------------|------------|
| Property Reference                 | SAP VG 21-0282         |  |               |                | Issued on Date | 15/11/2024 |
| Assessment Reference               | Plot 54                |  | Prop Type Ref | SAP VG 21-0282 |                |            |
| Property                           |                        |  |               |                |                |            |
|                                    |                        |  |               |                |                |            |
| SAP Rating                         | 93 A                   |  | DER           | 12.81          | TER            | 12.86      |
| Environmental                      | 88 B                   |  | % DER < TER   |                |                | 0.39       |
| CO <sub>2</sub> Emissions (t/year) | 1.3                    |  | DFEE          | 41.49          | TFEE           | 44.09      |
| Compliance Check                   | See BREL               |  | % DFEE < TFEE |                |                | 5.89       |
| % DPER < TPER                      | 0.23                   |  | DPER          | 67.36          | TPER           | 67.52      |
|                                    |                        |  |               |                |                |            |
| Assessor Details                   | Miss Victoria Gartside |  |               |                | Assessor ID    | AL30-0001  |
| Client                             |                        |  |               |                |                |            |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF ENERGY RATING

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 25.4100 (1b)              | x 2.8400 (2b)                   | = 72.1644 (1b) - (3b)       |
| First floor                                            | 40.1800 (1c)              | x 2.3900 (2c)                   | = 96.0302 (1c) - (3c)       |
| Second floor                                           | 40.1800 (1d)              | x 2.6000 (2d)                   | = 104.4680 (1d) - (3d)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 272.6626 (5)              |

## 2. Ventilation rate

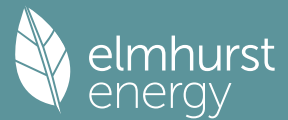
|                                                                                                  | m <sup>3</sup> per hour                 |
|--------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of open chimneys                                                                          | 0 * 80 = 0.0000 (6a)                    |
| Number of open flues                                                                             | 0 * 20 = 0.0000 (6b)                    |
| Number of chimneys / flues attached to closed fire                                               | 0 * 10 = 0.0000 (6c)                    |
| Number of flues attached to solid fuel boiler                                                    | 0 * 20 = 0.0000 (6d)                    |
| Number of flues attached to other heater                                                         | 0 * 35 = 0.0000 (6e)                    |
| Number of blocked chimneys                                                                       | 0 * 20 = 0.0000 (6f)                    |
| Number of intermittent extract fans                                                              | 6 * 10 = 60.0000 (7a)                   |
| Number of passive vents                                                                          | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                     | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) | 60.0000 / (5) = 0.2201 (8)              |
| Pressure test                                                                                    | Yes                                     |
| Pressure Test Method                                                                             | Blower Door                             |
| Measured/design AP50                                                                             | 4.0000 (17)                             |
| Infiltration rate                                                                                | 0.4201 (18)                             |
| Number of sides sheltered                                                                        | 1 (19)                                  |
| Shelter factor                                                                                   | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                             | (21) = (18) x (20) = 0.3885 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4954 | 0.4857 | 0.4760 | 0.4274 | 0.4177 | 0.3691 | 0.3691 | 0.3594 | 0.3885 | 0.4177 | 0.4371 | 0.4565 (22b) |
| Effective ac    | 0.6227 | 0.6179 | 0.6133 | 0.5913 | 0.5872 | 0.5681 | 0.5681 | 0.5646 | 0.5755 | 0.5872 | 0.5955 | 0.6042 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K    |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|------------------|
| Solid front door                                               |                         |                            | 2.1400                    | 1.1000                        | 2.3540       |                                      | (26)             |
| Windows (Uw = 1.30)                                            |                         |                            | 15.6300                   | 1.2357                        | 19.3146      |                                      | (27)             |
| Ground floor                                                   |                         |                            | 25.4100                   | 0.1300                        | 3.3033       | 0.0000                               | 0.0000 (28a)     |
| Exposed floor                                                  |                         |                            | 14.7600                   | 0.2000                        | 2.9520       | 20.0000                              | 295.2000 (28b)   |
| Brick wall                                                     | 125.8800                | 17.7700                    | 108.1100                  | 0.1900                        | 20.5409      | 110.0000                             | 11892.1000 (29a) |
| Retaining wall                                                 | 12.9200                 |                            | 12.9200                   | 0.1800                        | 2.3256       | 110.0000                             | 1421.2000 (29a)  |
| Garage wall                                                    | 21.3200                 |                            | 21.3200                   | 0.1400                        | 2.9848       | 110.0000                             | 2345.2000 (29a)  |
| Plane roof                                                     | 40.1800                 |                            | 40.1800                   | 0.0900                        | 3.6162       | 9.0000                               | 361.6200 (30)    |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 240.4700                  |                               |              |                                      | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 57.3914      |                                      | (33)             |
| Party Wall 1                                                   |                         |                            | 69.1400                   | 0.0000                        | 0.0000       | 140.0000                             | 9679.6000 (32)   |
| Internal Wall                                                  |                         |                            | 18.2000                   |                               |              | 75.0000                              | 1365.0000 (32c)  |
| Internal Wall                                                  |                         |                            | 146.3400                  |                               |              | 9.0000                               | 1317.0600 (32c)  |
| Internal Floor 1                                               |                         |                            | 65.5900                   |                               |              | 18.0000                              | 1180.6200 (32d)  |
| Internal Ceiling 1                                             |                         |                            | 65.5900                   |                               |              | 9.0000                               | 590.3100 (32e)   |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 30447.9100 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 287.8691 (35)    |

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## List of Thermal Bridges

|                                                                  | Length  | Psi-value             | Total        |
|------------------------------------------------------------------|---------|-----------------------|--------------|
| K1 Element                                                       | 12.3300 | 0.0240                | 0.2959       |
| E2 Other lintels (including other steel lintels)                 | 9.5000  | 0.0220                | 0.2090       |
| E3 Sill                                                          | 30.3000 | 0.0170                | 0.5151       |
| E4 Jamb                                                          | 20.1900 | 0.0920                | 1.8575       |
| E5 Ground floor (normal)                                         | 27.8700 | 0.0010                | 0.0279       |
| E6 Intermediate floor within a dwelling                          | 9.1000  | 0.0600                | 0.5460       |
| E10 Eaves (insulation at ceiling level)                          | 8.8500  | 0.0560                | 0.4956       |
| E12 Gable (insulation at ceiling level)                          | 18.5000 | 0.0460                | 0.8510       |
| E16 Corner (normal)                                              | 5.6800  | -0.0880               | -0.4998      |
| E17 Corner (inverted - internal area greater than external area) | 7.9900  | 0.0690                | 0.5513       |
| E20 Exposed floor (normal)                                       | 7.5100  | 0.3200                | 2.4032       |
| E21 Exposed floor (inverted)                                     | 15.6600 | 0.0380                | 0.5951       |
| E18 Party wall between dwellings                                 | 8.8300  | 0.0690                | 0.6093       |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0000                | 0.0000       |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000                | 0.0000       |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.4800                | 4.2384       |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)       |         |                       | 12.6954 (36) |
| Point Thermal bridges                                            |         |                       | 0.0000       |
| Total fabric heat loss                                           |         | (33) + (36) + (36a) = | 70.0868 (37) |

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

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 56.0306  | 55.6019  | 55.1816  | 53.2077  | 52.8384  | 51.1191  | 51.1191  | 50.8008  | 51.7814  | 52.8384  | 53.5855  | 54.3666 (38)  |
| Heat transfer coeff       | 126.1174 | 125.6887 | 125.2684 | 123.2945 | 122.9252 | 121.2060 | 121.2060 | 120.8876 | 121.8682 | 122.9252 | 123.6723 | 124.4534 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 123.2927      |
| HLP                       | 1.1924   | 1.1883   | 1.1843   | 1.1657   | 1.1622   | 1.1459   | 1.1459   | 1.1429   | 1.1522   | 1.1622   | 1.1693   | 1.1766 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.1657        |
| Days in mont              | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31            |

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

|                                                                 |          |          |          |          |          |          |          |          |          |          |            |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|---------------|
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |          |            | 2.7869 (42)   |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |          |            | 70.6752 (42a) |
| Hot water usage for baths                                       |          |          |          |          |          |          |          |          |          |          |            | 30.5292 (42b) |
| Hot water usage for other uses                                  |          |          |          |          |          |          |          |          |          |          |            | 43.1707 (42c) |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |            | 133.0583 (43) |
| Daily hot water use                                             | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541 | 128.3069 | 133.5529 | 139.3648   | 144.3752 (44) |
| Energy conte                                                    | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764 | 158.2152 | 181.2300 | 198.5507   | 226.0566 (45) |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total =  | Sum(45)m = | 2210.0711     |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |            |               |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |            |               |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |            |               |
| Primary loss                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000 (57)   |
| Combi loss                                                      | 2.5528   | 2.3647   | 2.6361   | 2.4472   | 2.4735   | 2.3138   | 2.2934   | 2.3113   | 2.2561   | 2.4036   | 2.4141     | 2.5334 (61)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |            |               |
| WWHRS                                                           | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337 | 200.9648   | 228.5900 (62) |
| PV diverter                                                     | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000    | -0.0000 (63a) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000 (63b)  |
| FGHRS                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000 (63c)  |
| Output from w/h                                                 | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337 | 200.9648   | 228.5900 (64) |
| Electric shower(s)                                              |          |          |          |          |          |          |          |          |          |          |            |               |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000 (64a)  |
| Heat gains from water heating, kWh/month                        | 76.8636  | 67.6635  | 71.1291  | 60.7732  | 57.6991  | 50.6731  | 49.0727  | 51.7750  | 53.1706  | 60.8599  | 66.6216    | 75.7972 (65)  |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
| (66)m                                                                               | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 33.0002   | 29.3105   | 23.8369   | 18.0461   | 13.4897   | 11.3885   | 12.3057   | 15.9954   | 21.4690   | 27.2599   | 31.8163   | 33.9174 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 396.0188  | 400.1283  | 389.7726  | 367.7267  | 339.8976  | 313.7422  | 296.2688  | 292.1594  | 302.5151  | 324.5610  | 352.3901  | 378.5454 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 (71) |
| Water heating gains (Table 5)                                                       | 103.3114  | 100.6898  | 95.6036   | 84.4072   | 77.5525   | 70.3794   | 65.9580   | 69.5900   | 73.8480   | 81.8009   | 92.5301   | 101.8779 (72)  |
| Total internal gains                                                                | 645.5769  | 643.3750  | 622.4597  | 583.4264  | 544.1863  | 505.7566  | 484.7790  | 487.9913  | 508.0786  | 546.8683  | 589.9829  | 627.5872 (73)  |

## 6. Solar gains

| [Jan] | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |
|-------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| North | 1.4200     | 10.6334                        | 0.7300                            | 0.7000                             | 0.7700                       | 5.3471 (74)  |
| East  | 7.2100     | 19.6403                        | 0.7300                            | 0.7000                             | 0.7700                       | 50.1460 (76) |
| West  | 7.0000     | 19.6403                        | 0.7300                            | 0.7000                             | 0.7700                       | 48.6855 (80) |

# Full SAP Calculation Printout



|             |          |          |          |           |           |           |           |          |          |          |          |               |
|-------------|----------|----------|----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|
| Solar gains | 104.1786 | 203.5539 | 335.7596 | 492.2521  | 606.6636  | 622.7884  | 592.1794  | 506.2095 | 391.1845 | 241.5726 | 129.8276 | 85.7318 (83)  |
| Total gains | 749.7555 | 846.9290 | 958.2193 | 1075.6785 | 1150.8499 | 1128.5450 | 1076.9584 | 994.2008 | 899.2630 | 788.4409 | 719.8105 | 713.3190 (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 67.0625 | 67.2913 | 67.5170 | 68.5980 | 68.8041 | 69.7800 | 69.7800 | 69.9638 | 69.4008 | 68.8041 | 68.3884 | 67.9592      |
| alpha                                                                       | 5.4708  | 5.4861  | 5.5011  | 5.5732  | 5.5869  | 5.6520  | 5.6520  | 5.6643  | 5.6267  | 5.5869  | 5.5592  | 5.5306       |
| util living area                                                            | 0.9977  | 0.9951  | 0.9858  | 0.9490  | 0.8453  | 0.6592  | 0.4904  | 0.5500  | 0.8192  | 0.9731  | 0.9954  | 0.9983 (86)  |
| MIT                                                                         | 20.5247 | 20.5649 | 20.6347 | 20.7267 | 20.7950 | 20.8281 | 20.8342 | 20.8336 | 20.8110 | 20.7180 | 20.6065 | 20.5211 (87) |
| Th 2                                                                        | 19.9261 | 19.9294 | 19.9325 | 19.9476 | 19.9504 | 19.9635 | 19.9635 | 19.9659 | 19.9584 | 19.9504 | 19.9447 | 19.9387 (88) |
| util rest of house                                                          | 0.9969  | 0.9932  | 0.9800  | 0.9284  | 0.7899  | 0.5649  | 0.3776  | 0.4314  | 0.7369  | 0.9583  | 0.9933  | 0.9976 (89)  |
| MIT 2                                                                       | 19.3551 | 19.4094 | 19.5008 | 19.6280 | 19.7062 | 19.7486 | 19.7519 | 19.7545 | 19.7313 | 19.6225 | 19.4770 | 19.3623 (90) |
| Living area fraction                                                        | 19.5513 | 19.6032 | 19.6910 | 19.8123 | 19.8888 | 19.9296 | 19.9334 | 19.9354 | 19.9124 | 19.8062 | 19.6665 | 19.5567 (91) |
| MIT                                                                         | 19.5513 | 19.6032 | 19.6910 | 19.8123 | 19.8888 | 19.9296 | 19.9334 | 19.9354 | 19.9124 | 19.8062 | 19.6665 | 19.5567 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | -0.1500      |
| adjusted MIT                                                                | 19.4013 | 19.4532 | 19.5410 | 19.6623 | 19.7388 | 19.7796 | 19.7834 | 19.7854 | 19.7624 | 19.6562 | 19.5165 | 19.4067 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9963    | 0.9921    | 0.9773    | 0.9215    | 0.7769   | 0.5471   | 0.3576   | 0.4101   | 0.7187   | 0.9527        | 0.9921    | 0.9972 (94)    |
| Useful gains                                                                   | 746.9777  | 840.2274  | 936.4880  | 991.2024  | 894.0686 | 617.4684 | 385.0996 | 407.6762 | 646.3163 | 751.1155      | 714.1054  | 711.3010 (95)  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000       | 7.1000    | 4.2000 (96)    |
| Heat loss rate W                                                               | 1904.5374 | 1829.1706 | 1633.6252 | 1326.9349 | 988.1686 | 627.8019 | 385.8489 | 409.2588 | 690.0672 | 1113.2410     | 1535.5734 | 1892.5217 (97) |
| Space heating kWh                                                              | 861.2244  | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214      | 591.4570  | 878.8282 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 4095.9088      |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000    | 0.0000 (98b)   |
| Solar heating contribution - total per year (kWh/year)                         |           |           |           |           |          |          |          |          |          |               |           | 0.0000         |
| Space heating kWh                                                              | 861.2244  | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214      | 591.4570  | 878.8282 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 4095.9088      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 38.7247 (99)   |

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

|                                                                                                      |          |          |          |           |           |           |           |           |           |          |          |                 |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                                                           |          |          |          |           |           |           |           |           |           |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |           |           |           |           |           |           |          |          | 88.6000 (206)   |
| Efficiency of main space heating system 2 (in %)                                                     |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %                                              |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (208)    |
|                                                                                                      | Jan      | Feb      | Mar      | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct      | Nov      | Dec             |
| Space heating requirement                                                                            | 861.2244 | 664.5699 | 518.6701 | 241.7274  | 70.0104   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 269.4214 | 591.4570 | 878.8282 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 88.6000  | 88.6000  | 88.6000  | 88.6000   | 88.6000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 88.6000  | 88.6000  | 88.6000 (210)   |
| Space heating fuel (main heating system)                                                             | 972.0366 | 750.0789 | 585.4065 | 272.8301  | 79.0185   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 304.0873 | 667.5587 | 991.9054 (211)  |
| Space heating efficiency (main heating system 2)                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (212)    |
| Space heating fuel (main heating system 2)                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (213)    |
| Space heating fuel (secondary)                                                                       | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating                                                                                        |          |          |          |           |           |           |           |           |           |          |          |                 |
| Water heating requirement                                                                            | 231.8023 | 204.0860 | 214.5762 | 183.3837  | 174.1448  | 152.9745  | 148.1562  | 156.2877  | 160.4713  | 183.6337 | 200.9648 | 228.5900 (64)   |
| Efficiency of water heater (217)m                                                                    | 86.5253  | 86.3073  | 85.7624  | 84.4796   | 81.9881   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 84.7176  | 86.1303  | 86.5794 (216)   |
| Fuel for water heating, kWh/month                                                                    | 267.9012 | 236.4643 | 250.1986 | 217.0745  | 212.4025  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 216.7599 | 233.3266 | 264.0236 (219)  |
| Space cooling fuel requirement                                                                       |          |          |          |           |           |           |           |           |           |          |          |                 |
| (221)m                                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (221)    |
| Pumps and Fa                                                                                         | 7.3041   | 6.5973   | 7.3041   | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041   | 7.0685   | 7.3041 (231)    |
| Lighting                                                                                             | 28.8849  | 23.1726  | 20.8643  | 15.2861   | 11.8074   | 9.6468    | 10.7711   | 14.0007   | 18.1855   | 23.8604  | 26.9503  | 29.6877 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |          |                 |
| (233a)m                                                                                              | -33.0601 | -51.3704 | -81.6378 | -98.5308  | -109.6129 | -103.2046 | -101.4318 | -93.7910  | -79.9001  | -61.4567 | -37.5969 | -27.7837 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |          |                 |
| (234a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (234a)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |          |                 |
| (235a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235a)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |          |                 |
| (235c)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235c)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |          |                 |
| (233b)m                                                                                              | -14.9249 | -36.2530 | -85.9866 | -150.0681 | -216.2967 | -224.4244 | -218.8576 | -173.8982 | -112.6673 | -55.7180 | -20.8495 | -11.3176 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |          |                 |
| (234b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |          |                 |
| (235b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235b)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |          |                 |
| (235d)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235d)   |
| Annual totals kWh/year                                                                               |          |          |          |           |           |           |           |           |           |          |          |                 |
| Space heating fuel - main system 1                                                                   |          |          |          |           |           |           |           |           |           |          |          | 4622.9219 (211) |
| Space heating fuel - main system 2                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (215)    |
| Efficiency of water heater                                                                           |          |          |          |           |           |           |           |           |           |          |          | 79.6000         |
| Water heating fuel used                                                                              |          |          |          |           |           |           |           |           |           |          |          | 2674.3945 (219) |
| Space cooling fuel                                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (221)    |

Electricity for pumps and fans:

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|                                                     |                |
|-----------------------------------------------------|----------------|
| central heating pump                                | 41.0000 (230c) |
| main heating flue fan                               | 45.0000 (230e) |
| Total electricity for the above, kWh/year           | 86.0000 (231)  |
| Electricity for lighting (calculated in Appendix L) | 233.1179 (232) |

|                                                               |                  |
|---------------------------------------------------------------|------------------|
| Energy saving/generation technologies (Appendices M ,N and Q) |                  |
| PV generation                                                 | -2200.6387 (233) |
| Wind generation                                               | 0.0000 (234)     |
| Hydro-electric generation (Appendix N)                        | 0.0000 (235a)    |
| Electricity generated - Micro CHP (Appendix N)                | 0.0000 (235)     |
| Appendix Q - special features                                 |                  |
| Energy saved or generated                                     | -0.0000 (236)    |
| Energy used                                                   | 0.0000 (237)     |
| Total delivered energy for all uses                           | 5415.7956 (238)  |

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

|                                             | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1               | 4622.9219        | 3.6400              | 168.2744 (240)      |
| Total CO2 associated with community systems |                  |                     | 0.0000 (473)        |
| Water heating (other fuel)                  | 2674.3945        | 3.6400              | 97.3480 (247)       |
| Energy for instantaneous electric shower(s) | 0.0000           | 16.4900             | 0.0000 (247a)       |
| Pumps, fans and electric keep-hot           | 86.0000          | 16.4900             | 14.1814 (249)       |
| Energy for lighting                         | 233.1179         | 16.4900             | 38.4411 (250)       |
| Additional standing charges                 |                  |                     | 92.0000 (251)       |
| Energy saving/generation technologies       |                  |                     |                     |
| PV Unit electricity used in dwelling        | -879.3767        | 16.4900             | -145.0092           |
| PV Unit electricity exported                | -1321.2619       | 5.5900              | -73.8585            |
| Total                                       |                  |                     | -218.8678 (252)     |
| Total energy cost                           |                  |                     | 191.3771 (255)      |

## 11a. SAP rating - Individual heating systems

|                                  |              |
|----------------------------------|--------------|
| Energy cost deflator (Table 12): | 0.3600 (256) |
| Energy cost factor (ECF)         | 0.4570 (257) |
| SAP value                        | 92.5927      |
| SAP rating (Section 12)          | 93 (258)     |
| SAP band                         | A            |

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

|                                             | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1               | 4622.9219          | 0.2100                        | 970.8136 (261)           |
| Total CO2 associated with community systems |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                  | 2674.3945          | 0.2100                        | 561.6228 (264)           |
| Space and water heating                     |                    |                               | 1532.4364 (265)          |
| Pumps, fans and electric keep-hot           | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                         | 233.1179           | 0.1443                        | 33.6461 (268)            |
| Energy saving/generation technologies       |                    |                               |                          |
| PV Unit electricity used in dwelling        | -879.3767          | 0.1332                        | -117.1173                |
| PV Unit electricity exported                | -1321.2619         | 0.1223                        | -161.6557                |
| Total                                       |                    |                               | -278.7731 (269)          |
| Total CO2, kg/year                          |                    |                               | 1299.2388 (272)          |
| CO2 emissions per m2                        |                    |                               | 12.2800 (273)            |
| EI value                                    |                    |                               | 88.4527                  |
| EI rating                                   |                    |                               | 88 (274)                 |
| EI band                                     |                    |                               | B                        |

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

### 1. Overall dwelling characteristics

|                                                        | Area<br>(m2) | Storey height<br>(m)                        | Volume<br>(m3)         |
|--------------------------------------------------------|--------------|---------------------------------------------|------------------------|
| Ground floor                                           | 25.4100 (1b) | x 2.8400 (2b)                               | = 72.1644 (1b) - (3b)  |
| First floor                                            | 40.1800 (1c) | x 2.3900 (2c)                               | = 96.0302 (1c) - (3c)  |
| Second floor                                           | 40.1800 (1d) | x 2.6000 (2d)                               | = 104.4680 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700     |                                             | (4)                    |
| Dwelling volume                                        |              | (3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = | 272.6626 (5)           |

### 2. Ventilation rate

|                                                    | m3 per hour           |
|----------------------------------------------------|-----------------------|
| Number of open chimneys                            | 0 * 80 = 0.0000 (6a)  |
| Number of open flues                               | 0 * 20 = 0.0000 (6b)  |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 (6c)  |
| Number of flues attached to solid fuel boiler      | 0 * 20 = 0.0000 (6d)  |
| Number of flues attached to other heater           | 0 * 35 = 0.0000 (6e)  |
| Number of blocked chimneys                         | 0 * 20 = 0.0000 (6f)  |
| Number of intermittent extract fans                | 6 * 10 = 60.0000 (7a) |

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Number of passive vents  
Number of flueless gas fires

0 \* 10 = 0.0000 (7b)  
0 \* 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =  
Pressure test  
Pressure Test Method  
Measured/design AP50  
Infiltration rate  
Number of sides sheltered

Air changes per hour  
60.0000 / (5) = 0.2201 (8)  
Yes  
Blower Door  
4.0000 (17)  
0.4201 (18)  
1 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)  
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3885 (21)

|                 |        |        |        |        |        |        |        |        |        |        |        |              |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
| Wind factor     | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Adj infilt rate | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Effective ac    | 0.4954 | 0.4857 | 0.4760 | 0.4274 | 0.4177 | 0.3691 | 0.3691 | 0.3594 | 0.3885 | 0.4177 | 0.4371 | 0.4565 (22b) |
|                 | 0.6227 | 0.6179 | 0.6133 | 0.5913 | 0.5872 | 0.5681 | 0.5681 | 0.5646 | 0.5755 | 0.5872 | 0.5955 | 0.6042 (25)  |

## 3. Heat losses and heat loss parameter

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K    |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------|
| Solid front door                                            |                         |                            | 2.1400                    | 1.1000                        | 2.3540       |                                | (26)             |
| Windows (Uw = 1.30)                                         |                         |                            | 15.6300                   | 1.2357                        | 19.3146      |                                | (27)             |
| Ground floor                                                |                         |                            | 25.4100                   | 0.1300                        | 3.3033       | 0.0000                         | 0.0000 (28a)     |
| Exposed floor                                               |                         |                            | 14.7600                   | 0.2000                        | 2.9520       | 20.0000                        | 295.2000 (28b)   |
| Brick wall                                                  | 125.8800                | 17.7700                    | 108.1100                  | 0.1900                        | 20.5409      | 110.0000                       | 11892.1000 (29a) |
| Retaining wall                                              | 12.9200                 |                            | 12.9200                   | 0.1800                        | 2.3256       | 110.0000                       | 1421.2000 (29a)  |
| Garage wall                                                 | 21.3200                 |                            | 21.3200                   | 0.1400                        | 2.9848       | 110.0000                       | 2345.2000 (29a)  |
| Plane roof                                                  | 40.1800                 |                            | 40.1800                   | 0.0900                        | 3.6162       | 9.0000                         | 361.6200 (30)    |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 240.4700                  |                               |              |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 57.3914      |                                | (33)             |
| Party Wall 1                                                |                         |                            | 69.1400                   | 0.0000                        | 0.0000       | 140.0000                       | 9679.6000 (32)   |
| Internal Wall                                               |                         |                            | 18.2000                   |                               |              | 75.0000                        | 1365.0000 (32c)  |
| Internal Wall                                               |                         |                            | 146.3400                  |                               |              | 9.0000                         | 1317.0600 (32c)  |
| Internal Floor 1                                            |                         |                            | 65.5900                   |                               |              | 18.0000                        | 1180.6200 (32d)  |
| Internal Ceiling 1                                          |                         |                            | 65.5900                   |                               |              | 9.0000                         | 590.3100 (32e)   |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
List of Thermal Bridges (28)...(30) + (32) + (32a)...(32e) = 30447.9100 (34)  
287.8691 (35)

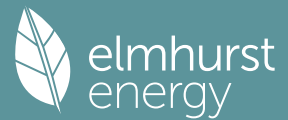
| K1 Element                                                       | Length  | Psi-value | Total                              |
|------------------------------------------------------------------|---------|-----------|------------------------------------|
| E2 Other lintels (including other steel lintels)                 | 12.3300 | 0.0240    | 0.2959                             |
| E3 Sill                                                          | 9.5000  | 0.0220    | 0.2090                             |
| E4 Jamb                                                          | 30.3000 | 0.0170    | 0.5151                             |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                             |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010    | 0.0279                             |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460                             |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560    | 0.4956                             |
| E16 Corner (normal)                                              | 18.5000 | 0.0460    | 0.8510                             |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880   | -0.4998                            |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690    | 0.5513                             |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032                             |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380    | 0.5951                             |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690    | 0.6093                             |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000    | 0.0000                             |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.4800    | 4.2384                             |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)       |         |           | 12.6954 (36)                       |
| Point Thermal bridges                                            |         |           | (36a) = 0.0000                     |
| Total fabric heat loss                                           |         |           | (33) + (36) + (36a) = 70.0868 (37) |

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |          |          |          |          |          |          |          |          |          |          |          |               |
| (38)m                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Heat transfer coeff                                                 | 56.0306  | 55.6019  | 55.1816  | 53.2077  | 52.8384  | 51.1191  | 51.1191  | 50.8008  | 51.7814  | 52.8384  | 53.5855  | 54.3666 (38)  |
| Average = Sum(39)m / 12 =                                           | 126.1174 | 125.6887 | 125.2684 | 123.2945 | 122.9252 | 121.2060 | 121.2060 | 120.8876 | 121.8682 | 122.9252 | 123.6723 | 124.4534 (39) |
|                                                                     |          |          |          |          |          |          |          |          |          |          |          | 123.2927      |
| HLP                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| HLP (average)                                                       | 1.1924   | 1.1883   | 1.1843   | 1.1657   | 1.1622   | 1.1459   | 1.1459   | 1.1429   | 1.1522   | 1.1622   | 1.1693   | 1.1766 (40)   |
| Days in mont                                                        | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31            |

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

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |          |          | 2.7869 (42)   |
| Hot water usage for mixer showers                               | 70.9471  | 69.8809  | 68.3272  | 65.3546  | 63.1608  | 60.7144  | 59.3238  | 60.8657  | 62.5559  | 65.1827  | 68.2192  | 70.6752 (42a) |
| Hot water usage for baths                                       | 30.6328  | 30.1778  | 29.5372  | 28.3559  | 27.4714  | 26.4907  | 25.9609  | 26.5971  | 27.2897  | 28.3392  | 29.5448  | 30.5292 (42b) |
| Hot water usage for other uses                                  | 43.1707  | 41.6009  | 40.0310  | 38.4612  | 36.8913  | 35.3215  | 35.3215  | 36.8913  | 38.4612  | 40.0310  | 41.6009  | 43.1707 (42c) |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |          | 133.0583 (43) |
|                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Daily hot water use                                             | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541 | 128.3069 | 133.5529 | 139.3648 | 144.3752 (44) |
| Energy content (annual)                                         | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764 | 158.2152 | 181.2300 | 198.5507 | 226.0566 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          | 2210.0711     |
|                                                                 | 34.3874  | 30.2582  | 31.7910  | 27.1405  | 25.7507  | 22.5991  | 21.8794  | 23.0965  | 23.7323  | 27.1845  | 29.7826  | 33.9085 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (56)   |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (57)   |
| Primary loss                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (59)   |
| Combi loss                                                      | 2.5528   | 2.3647   | 2.6361   | 2.4472   | 2.4735   | 2.3138   | 2.2934   | 2.3113   | 2.2561   | 2.4036   | 2.4141   | 2.5334 (61)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337 | 200.9648 | 228.5900 (62) |

# Full SAP Calculation Printout



|                                                                                |          |          |          |          |          |          |          |          |          |          |          |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| WWHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63a)   |
| PV diverter                                                                    | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000 (63b)  |
| Solar input                                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63c)   |
| FGHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63d)   |
| Output from w/h                                                                | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337 | 200.9648 | 228.5900 | (64)           |
| Total per year (kWh/year) = Sum(64)m =                                         |          |          |          |          |          |          |          |          |          |          |          |          | 2239.0711 (64) |
| Electric shower(s)                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (64a)   |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (64a)   |
| Heat gains from water heating, kWh/month                                       | 76.8636  | 67.6635  | 71.1291  | 60.7732  | 57.6991  | 50.6731  | 49.0727  | 51.7750  | 53.1706  | 60.8599  | 66.6216  | 75.7972  | (65)           |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 33.0002   | 29.3105   | 23.8369   | 18.0461   | 13.4897   | 11.3885   | 12.3057   | 15.9954   | 21.4690   | 27.2599   | 31.8163   | 33.9174   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 396.0188  | 400.1283  | 389.7726  | 367.7267  | 339.8976  | 313.7422  | 296.2688  | 292.1594  | 302.5151  | 324.5610  | 352.3901  | 378.5454  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | (71) |
| Water heating gains (Table 5)                                                       | 103.3114  | 100.6898  | 95.6036   | 84.4072   | 77.5525   | 70.3794   | 65.9580   | 69.5900   | 73.8480   | 81.8009   | 92.5301   | 101.8779  | (72) |
| Total internal gains                                                                | 645.5769  | 643.3750  | 622.4597  | 583.4264  | 544.1863  | 505.7566  | 484.7790  | 487.9913  | 508.0786  | 546.8683  | 589.9829  | 627.5872  | (73) |

## 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |      |
|-------------|----------|----------|----------|------------|------------------------|-----------|-----------------------------------|------------------------------------|----------|------------------------------|----------|--------------|------|
| North       |          |          |          | 1.4200     | 10.6334                |           | 0.7300                            | 0.7000                             |          | 0.7700                       |          | 5.3471 (74)  |      |
| East        |          |          |          | 7.2100     | 19.6403                |           | 0.7300                            | 0.7000                             |          | 0.7700                       |          | 50.1460 (76) |      |
| West        |          |          |          | 7.0000     | 19.6403                |           | 0.7300                            | 0.7000                             |          | 0.7700                       |          | 48.6855 (80) |      |
|             |          |          |          |            |                        |           |                                   |                                    |          |                              |          |              |      |
| Solar gains | 104.1786 | 203.5539 | 335.7596 | 492.2521   | 606.6636               | 622.7884  | 592.1794                          | 506.2095                           | 391.1845 | 241.5726                     | 129.8276 | 85.7318      | (83) |
| Total gains | 749.7555 | 846.9290 | 958.2193 | 1075.6785  | 1150.8499              | 1128.5450 | 1076.9584                         | 994.2008                           | 899.2630 | 788.4409                     | 719.8105 | 713.3190     | (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 67.0625 | 67.2913 | 67.5170 | 68.5980 | 68.8041 | 69.7800 | 69.7800 | 69.9638 | 69.4008 | 68.8041 | 68.3884 | 67.9592 |              |
| alpha                                                                       | 5.4708  | 5.4861  | 5.5011  | 5.5732  | 5.5869  | 5.6520  | 5.6520  | 5.6643  | 5.6267  | 5.5869  | 5.5592  | 5.5306  |              |
| util living area                                                            | 0.9977  | 0.9951  | 0.9858  | 0.9490  | 0.8453  | 0.6592  | 0.4904  | 0.5500  | 0.8192  | 0.9731  | 0.9954  | 0.9983  | (86)         |
| MIT                                                                         | 20.5247 | 20.5649 | 20.6347 | 20.7267 | 20.7950 | 20.8281 | 20.8342 | 20.8336 | 20.8110 | 20.7180 | 20.6065 | 20.5211 | (87)         |
| Th 2                                                                        | 19.9261 | 19.9294 | 19.9325 | 19.9476 | 19.9504 | 19.9635 | 19.9635 | 19.9659 | 19.9584 | 19.9504 | 19.9447 | 19.9387 | (88)         |
| util rest of house                                                          | 0.9969  | 0.9932  | 0.9800  | 0.9284  | 0.7899  | 0.5649  | 0.3776  | 0.4314  | 0.7369  | 0.9583  | 0.9933  | 0.9976  | (89)         |
| MIT 2                                                                       | 19.3551 | 19.4094 | 19.5008 | 19.6280 | 19.7062 | 19.7486 | 19.7519 | 19.7545 | 19.7313 | 19.6225 | 19.4770 | 19.3623 | (90)         |
| Living area fraction                                                        | 19.5513 | 19.6032 | 19.6910 | 19.8123 | 19.8888 | 19.9296 | 19.9334 | 19.9354 | 19.9124 | 19.8062 | 19.6665 | 19.5567 | (91)         |
| MIT                                                                         | 19.5513 | 19.6032 | 19.6910 | 19.8123 | 19.8888 | 19.9296 | 19.9334 | 19.9354 | 19.9124 | 19.8062 | 19.6665 | 19.5567 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | -0.1500 |              |
| adjusted MIT                                                                | 19.4013 | 19.4532 | 19.5410 | 19.6623 | 19.7388 | 19.7796 | 19.7834 | 19.7854 | 19.7624 | 19.6562 | 19.5165 | 19.4067 | (93)         |

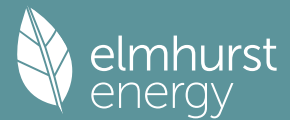
## 8. Space heating requirement

|                                                                                |               |           |           |           |          |          |          |          |          |           |           |           |              |
|--------------------------------------------------------------------------------|---------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|--------------|
| Utilisation                                                                    | Jan           | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |              |
| Useful gains                                                                   | 0.9963        | 0.9921    | 0.9773    | 0.9215    | 0.7769   | 0.5471   | 0.3576   | 0.4101   | 0.7187   | 0.9527    | 0.9921    | 0.9972    | (94)         |
| Ext temp.                                                                      | 746.9777      | 840.2274  | 936.4880  | 991.2024  | 894.0686 | 617.4684 | 385.0996 | 407.6762 | 646.3163 | 751.1155  | 714.1054  | 711.3010  | (95)         |
| Heat loss rate W                                                               | 4.3000        | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000   | 7.1000    | 4.2000    | (96)         |
| Space heating kWh                                                              | 1904.5374     | 1829.1706 | 1633.6252 | 1326.9349 | 988.1686 | 627.8019 | 385.8489 | 409.2588 | 690.0672 | 1113.2410 | 1535.5734 | 1892.5217 | (97)         |
| Space heating requirement - total per year (kWh/year)                          | 861.2244      | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214  | 591.4570  | 878.8282  | (98a)        |
| Solar heating kWh                                                              | 0.0000        | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | (98b)        |
| Solar heating contribution - total per year (kWh/year)                         | 861.2244      | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214  | 591.4570  | 878.8282  | (98c)        |
| Space heating requirement after solar contribution - total per year (kWh/year) |               |           |           |           |          |          |          |          |          |           |           | 4095.9088 |              |
| Space heating per m2                                                           | (98c) / (4) = |           |           |           |          |          |          |          |          |           |           |           | 38.7247 (99) |

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

|                                                                       |     |     |     |     |     |     |     |     |     |     |     |               |
|-----------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------------|
| -----                                                                 |     |     |     |     |     |     |     |     |     |     |     |               |
| Fraction of space heat from secondary/supplementary system (Table 11) |     |     |     |     |     |     |     |     |     |     |     | 0.0000 (201)  |
| Fraction of space heat from main system(s)                            |     |     |     |     |     |     |     |     |     |     |     | 1.0000 (202)  |
| Efficiency of main space heating system 1 (in %)                      |     |     |     |     |     |     |     |     |     |     |     | 88.6000 (206) |
| Efficiency of main space heating system 2 (in %)                      |     |     |     |     |     |     |     |     |     |     |     | 0.0000 (207)  |
| Efficiency of secondary/supplementary heating system, %               |     |     |     |     |     |     |     |     |     |     |     | 0.0000 (208)  |
|                                                                       | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec           |
| Space heating requirement                                             |     |     |     |     |     |     |     |     |     |     |     |               |

# Full SAP Calculation Printout



|                                                                                                              |          |          |          |           |           |           |           |           |           |          |          |            |        |
|--------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------|--------|
| Space heating efficiency (main heating system 1)                                                             | 861.2244 | 664.5699 | 518.6701 | 241.7274  | 70.0104   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 269.4214 | 591.4570 | 878.8282   | (98)   |
| Space heating fuel (main heating system)                                                                     | 88.6000  | 88.6000  | 88.6000  | 88.6000   | 88.6000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 88.6000  | 88.6000  | 88.6000    | (210)  |
| Space heating efficiency (main heating system 2)                                                             | 972.0366 | 750.0789 | 585.4065 | 272.8301  | 79.0185   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 304.0873 | 667.5587 | 991.9054   | (211)  |
| Space heating fuel (main heating system 2)                                                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (212)  |
| Space heating fuel (secondary)                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (213)  |
| Space heating fuel (secondary)                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (215)  |
| Water heating requirement                                                                                    | 231.8023 | 204.0860 | 214.5762 | 183.3837  | 174.1448  | 152.9745  | 148.1562  | 156.2877  | 160.4713  | 183.6337 | 200.9648 | 228.5900   | (64)   |
| Efficiency of water heater (217)m                                                                            | 86.5253  | 86.3073  | 85.7624  | 84.4796   | 81.9881   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 84.7176  | 86.1303  | 79.6000    | (216)  |
| Fuel for water heating, kWh/month                                                                            | 267.9012 | 236.4643 | 250.1986 | 217.0745  | 212.4025  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 216.7599 | 233.3266 | 264.0236   | (219)  |
| Space cooling fuel requirement (221)m                                                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (221)  |
| Pumps and Fa                                                                                                 | 7.3041   | 6.5973   | 7.3041   | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.0685    | 7.3041   | 7.0685   | 7.3041     | (231)  |
| Lighting                                                                                                     | 28.8849  | 23.1726  | 20.8643  | 15.2861   | 11.8074   | 9.6468    | 10.7711   | 14.0007   | 18.1855   | 23.8604  | 26.9503  | 29.6877    | (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)m                                        | -33.0601 | -51.3704 | -81.6378 | -98.5308  | -109.6129 | -103.2046 | -101.4318 | -93.7910  | -79.9001  | -61.4567 | -37.5969 | -27.7837   | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m                  | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) (233b)m                                        | -14.9249 | -36.2530 | -85.9866 | -150.0681 | -216.2967 | -224.4244 | -218.8576 | -173.8982 | -112.6673 | -55.7180 | -20.8495 | -11.3176   | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m                  | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000     | (235d) |
| Annual totals kWh/year                                                                                       |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Space heating fuel - main system 1                                                                           |          |          |          |           |           |           |           |           |           |          |          | 4622.9219  | (211)  |
| Space heating fuel - main system 2                                                                           |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (213)  |
| Space heating fuel - secondary                                                                               |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (215)  |
| Efficiency of water heater                                                                                   |          |          |          |           |           |           |           |           |           |          |          | 79.6000    |        |
| Water heating fuel used                                                                                      |          |          |          |           |           |           |           |           |           |          |          | 2674.3945  | (219)  |
| Space cooling fuel                                                                                           |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (221)  |
| Electricity for pumps and fans:                                                                              |          |          |          |           |           |           |           |           |           |          |          |            |        |
| central heating pump                                                                                         |          |          |          |           |           |           |           |           |           |          |          | 41.0000    | (230c) |
| main heating flue fan                                                                                        |          |          |          |           |           |           |           |           |           |          |          | 45.0000    | (230e) |
| Total electricity for the above, kWh/year                                                                    |          |          |          |           |           |           |           |           |           |          |          | 86.0000    | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                          |          |          |          |           |           |           |           |           |           |          |          | 233.1179   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                                |          |          |          |           |           |           |           |           |           |          |          |            |        |
| PV generation                                                                                                |          |          |          |           |           |           |           |           |           |          |          | -2200.6387 | (233)  |
| Wind generation                                                                                              |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (234)  |
| Hydro-electric generation (Appendix N)                                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (235a) |
| Electricity generated - Micro CHP (Appendix N)                                                               |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (235)  |
| Appendix Q - special features                                                                                |          |          |          |           |           |           |           |           |           |          |          |            |        |
| Energy saved or generated                                                                                    |          |          |          |           |           |           |           |           |           |          |          | -0.0000    | (236)  |
| Energy used                                                                                                  |          |          |          |           |           |           |           |           |           |          |          | 0.0000     | (237)  |
| Total delivered energy for all uses                                                                          |          |          |          |           |           |           |           |           |           |          |          | 5415.7956  | (238)  |

## 10a. Fuel costs - using BEDF prices (554)

|                                             | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |        |
|---------------------------------------------|---------------|------------------|------------------|--------|
| Space heating - main system 1               | 4622.9219     | 5.6000           | 258.8836         | (240)  |
| Total CO2 associated with community systems |               |                  | 0.0000           | (473)  |
| Water heating (other fuel)                  | 2674.3945     | 5.6000           | 149.7661         | (247)  |
| Energy for instantaneous electric shower(s) | 0.0000        | 26.0600          | 0.0000           | (247a) |
| Pumps, fans and electric keep-hot           | 86.0000       | 26.0600          | 22.4116          | (249)  |
| Energy for lighting                         | 233.1179      | 26.0600          | 60.7505          | (250)  |
| Additional standing charges                 |               |                  | 99.0000          | (251)  |
| Energy saving/generation technologies       |               |                  |                  |        |
| PV Unit electricity used in dwelling        | -879.3767     | 26.0600          | -229.1656        |        |
| PV Unit electricity exported                | -1321.2619    | 5.8100           | -76.7653         |        |
| Total                                       |               |                  | -305.9309        | (252)  |
| Total energy cost                           |               |                  | 284.8809         | (255)  |

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

|                                             | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year |       |
|---------------------------------------------|-----------------|----------------------------|-----------------------|-------|
| Space heating - main system 1               | 4622.9219       | 0.2100                     | 970.8136              | (261) |
| Total CO2 associated with community systems |                 |                            | 0.0000                | (373) |
| Water heating (other fuel)                  | 2674.3945       | 0.2100                     | 561.6228              | (264) |
| Space and water heating                     |                 |                            | 1532.4364             | (265) |
| Pumps, fans and electric keep-hot           | 86.0000         | 0.1387                     | 11.9293               | (267) |
| Energy for lighting                         | 233.1179        | 0.1443                     | 33.6461               | (268) |
| Energy saving/generation technologies       |                 |                            |                       |       |
| PV Unit electricity used in dwelling        | -879.3767       | 0.1332                     | -117.1173             |       |
| PV Unit electricity exported                | -1321.2619      | 0.1223                     | -161.6557             |       |
| Total                                       |                 |                            | -278.7731             | (269) |
| Total CO2, kg/year                          |                 |                            | 1299.2388             | (272) |

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

|  | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year |  |
|--|-----------------|----------------------------------|-------------------------|--|
|--|-----------------|----------------------------------|-------------------------|--|

# Full SAP Calculation Printout



|                                             |            |        |                  |
|---------------------------------------------|------------|--------|------------------|
| Space heating - main system 1               | 4622.9219  | 1.1300 | 5223.9017 (275)  |
| Total CO2 associated with community systems |            |        | 0.0000 (473)     |
| Water heating (other fuel)                  | 2674.3945  | 1.1300 | 3022.0658 (278)  |
| Space and water heating                     |            |        | 8245.9675 (279)  |
| Pumps, fans and electric keep-hot           | 86.0000    | 1.5128 | 130.1008 (281)   |
| Energy for lighting                         | 233.1179   | 1.5338 | 357.5639 (282)   |
| Energy saving/generation technologies       |            |        |                  |
| PV Unit electricity used in dwelling        | -879.3767  | 1.4921 | -1312.1603       |
| PV Unit electricity exported                | -1321.2619 | 0.4489 | -593.1622        |
| Total                                       |            |        | -1905.3225 (283) |
| Total Primary energy kWh/year               |            |        | 6828.3097 (286)  |

## SAP 10 EPC IMPROVEMENTS

Plot 54

Current energy efficiency rating: A 93  
Current environmental impact rating: B 88

N Solar water heating SAP increase too small  
U Solar photovoltaic panels Already installed  
V2 Wind turbine Not applicable

| Recommended measures: | SAP change | Cost change | CO2 change |
|-----------------------|------------|-------------|------------|
| (none)                |            |             |            |

Measures omitted - SAP change or cost saving too small:  
N Solar water heating + 0.6 -£ 22 -144 kg (11.0%)

| Recommended measures | Typical annual savings | Energy efficiency | Environmental impact |
|----------------------|------------------------|-------------------|----------------------|
| (none)               |                        |                   |                      |
| Total Savings        | £0                     | 0.00 kg/m²        |                      |

Potential energy efficiency rating: A 93  
Potential environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 554 TEST (31 Oct 2024)  
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, East Pennines):

|                          | Current    | Potential  | Saving     |
|--------------------------|------------|------------|------------|
| Electricity              | £83        | £83        | £0         |
| Mains gas                | £508       | £508       | £0         |
| Space heating            | £380       | £380       | £0         |
| Water heating            | £150       | £150       | £0         |
| Lighting                 | £61        | £61        | £0         |
| Generated (PV)           | -£306      | -£306      | £0         |
| Total cost of fuels      | £285       | £285       | £0         |
| Total cost of uses       | £285       | £285       | £0         |
| Delivered energy         | 51 kWh/m²  | 51 kWh/m²  | 0 kWh/m²   |
| Carbon dioxide emissions | 1.3 tonnes | 1.3 tonnes | 0.0 tonnes |
| CO2 emissions per m²     | 12 kg/m²   | 12 kg/m²   | 0 kg/m²    |
| Primary energy           | 65 kWh/m²  | 65 kWh/m²  | 0 kWh/m²   |

## SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

### 1. Overall dwelling characteristics

|                                                        | Area (m2)    | Storey height (m)               | Volume (m3)            |
|--------------------------------------------------------|--------------|---------------------------------|------------------------|
| Ground floor                                           | 25.4100 (1b) | x 2.8400 (2b)                   | = 72.1644 (1b) - (3b)  |
| First floor                                            | 40.1800 (1c) | x 2.3900 (2c)                   | = 96.0302 (1c) - (3c)  |
| Second floor                                           | 40.1800 (1d) | x 2.6000 (2d)                   | = 104.4680 (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700     |                                 | (4)                    |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 272.6626 (5)         |

### 2. Ventilation rate

|                                                    | m3 per hour           |
|----------------------------------------------------|-----------------------|
| Number of open chimneys                            | 0 * 80 = 0.0000 (6a)  |
| Number of open flues                               | 0 * 20 = 0.0000 (6b)  |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 (6c)  |
| Number of flues attached to solid fuel boiler      | 0 * 20 = 0.0000 (6d)  |
| Number of flues attached to other heater           | 0 * 35 = 0.0000 (6e)  |
| Number of blocked chimneys                         | 0 * 20 = 0.0000 (6f)  |
| Number of intermittent extract fans                | 6 * 10 = 60.0000 (7a) |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                       | 0 * 40 = 0.0000 (7c)  |
| Air changes per hour                               |                       |

# Full SAP Calculation Printout



Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 60.0000 / (5) = 0.2201 (8)  
Pressure test Yes  
Pressure Test Method Blower Door  
Measured/design AP50 4.0000 (17)  
Infiltration rate 0.4201 (18)  
Number of sides sheltered 1 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)  
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3885 (21)

|                  |        |        |        |        |        |        |        |        |        |        |        |        |       |
|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Wind speed       | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |       |
|                  | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22)  |
| Wind factor      | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infiltr rate |        |        |        |        |        |        |        |        |        |        |        |        |       |
|                  | 0.4954 | 0.4857 | 0.4760 | 0.4274 | 0.4177 | 0.3691 | 0.3691 | 0.3594 | 0.3885 | 0.4177 | 0.4371 | 0.4565 | (22b) |
| Effective ac     | 0.6227 | 0.6179 | 0.6133 | 0.5913 | 0.5872 | 0.5681 | 0.5681 | 0.5646 | 0.5755 | 0.5872 | 0.5955 | 0.6042 | (25)  |

### 3. Heat losses and heat loss parameter

| Element                                        | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |       |
|------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|-------------------|---------------|-------|
| Solid front door                               |             |                | 2.1400        | 1.1000               | 2.3540       |                   |               | (26)  |
| Windows (Uw = 1.30)                            |             |                | 15.6300       | 1.2357               | 19.3146      |                   |               | (27)  |
| Ground floor                                   |             |                | 25.4100       | 0.1300               | 3.3033       | 0.0000            | 0.0000        | (28a) |
| Exposed floor                                  |             |                | 14.7600       | 0.2000               | 2.9520       | 20.0000           | 295.2000      | (28b) |
| Brick wall                                     | 125.8800    | 17.7700        | 108.1100      | 0.1900               | 20.5409      | 110.0000          | 11892.1000    | (29a) |
| Retaining wall                                 |             |                | 12.9200       | 0.1800               | 2.3256       | 110.0000          | 1421.2000     | (29a) |
| Garage wall                                    |             |                | 21.3200       | 0.1400               | 2.9848       | 110.0000          | 2345.2000     | (29a) |
| Plane roof                                     |             |                | 40.1800       | 0.0900               | 3.6162       | 9.0000            | 361.6200      | (30)  |
| Total net area of external elements Aum(A, m2) |             |                | 240.4700      |                      |              |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               | (26)...(30) + (32) = | 57.3914      |                   |               | (33)  |
| Party Wall 1                                   |             |                | 69.1400       | 0.0000               | 0.0000       | 140.0000          | 9679.6000     | (32)  |
| Internal Wall                                  |             |                | 18.2000       |                      |              | 75.0000           | 1365.0000     | (32c) |
| Internal Wall                                  |             |                | 146.3400      |                      |              | 9.0000            | 1317.0600     | (32c) |
| Internal Floor 1                               |             |                | 65.5900       |                      |              | 18.0000           | 1180.6200     | (32d) |
| Internal Ceiling 1                             |             |                | 65.5900       |                      |              | 9.0000            | 590.3100      | (32e) |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K  
(28)...(30) + (32) + (32a)...(32e) = 30447.9100 (34)  
List of Thermal Bridges 287.8691 (35)

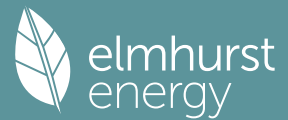
| K1 Element                                                       | Length  | Psi-value | Total                 |              |
|------------------------------------------------------------------|---------|-----------|-----------------------|--------------|
| E2 Other lintels (including other steel lintels)                 | 12.3300 | 0.0240    | 0.2959                |              |
| E3 Sill                                                          | 9.5000  | 0.0220    | 0.2090                |              |
| E4 Jamb                                                          | 30.3000 | 0.0170    | 0.5151                |              |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                |              |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010    | 0.0279                |              |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460                |              |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560    | 0.4956                |              |
| E16 Corner (normal)                                              | 18.5000 | 0.0460    | 0.8510                |              |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880   | -0.4998               |              |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690    | 0.5513                |              |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032                |              |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380    | 0.5951                |              |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690    | 0.6093                |              |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000    | 0.0000                |              |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.4800    | 4.2384                |              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)       |         |           |                       | 12.6954 (36) |
| Point Thermal bridges                                            |         |           |                       | 0.0000       |
| Total fabric heat loss                                           |         |           | (33) + (36) + (36a) = | 70.0868 (37) |

|                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|---------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |          |          |          |          |          |          |          |          |          |          |          |          |      |
| (38)m                                                               | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
|                                                                     | 56.0306  | 55.6019  | 55.1816  | 53.2077  | 52.8384  | 51.1191  | 51.1191  | 50.8008  | 51.7814  | 52.8384  | 53.5855  | 54.3666  | (38) |
| Heat transfer coeff                                                 | 126.1174 | 125.6887 | 125.2684 | 123.2945 | 122.9252 | 121.2060 | 121.2060 | 120.8876 | 121.8682 | 122.9252 | 123.6723 | 124.4534 | (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 123.2927 |      |
| HLP                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| HLP (average)                                                       | 1.1924   | 1.1883   | 1.1843   | 1.1657   | 1.1622   | 1.1459   | 1.1459   | 1.1429   | 1.1522   | 1.1622   | 1.1693   | 1.1766   | (40) |
| Days in mont                                                        | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

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

|                                                                 |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------|-----------|-------------|
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |                    |          |           | 2.7869 (42) |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|                                                                 | 70.9471  | 69.8809  | 68.3272  | 65.3546  | 63.1608  | 60.7144  | 59.3238  | 60.8657  | 62.5559  | 65.1827            | 68.2192  | 70.6752   | (42a)       |
| Hot water usage for baths                                       |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|                                                                 | 30.6328  | 30.1778  | 29.5372  | 28.3559  | 27.4714  | 26.4907  | 25.9609  | 26.5971  | 27.2897  | 28.3392            | 29.5448  | 30.5292   | (42b)       |
| Hot water usage for other uses                                  |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|                                                                 | 43.1707  | 41.6009  | 40.0310  | 38.4612  | 36.8913  | 35.3215  | 35.3215  | 36.8913  | 38.4612  | 40.0310            | 41.6009  | 43.1707   | (42c)       |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |                    |          | 133.0583  | (43)        |
|                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                | Nov      | Dec       |             |
| Daily hot water use                                             | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541 | 128.3069 | 133.5529           | 139.3648 | 144.3752  | (44)        |
| Energy conte                                                    | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764 | 158.2152 | 181.2300           | 198.5507 | 226.0566  | (45)        |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |          | 2210.0711 |             |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|                                                                 | 34.3874  | 30.2582  | 31.7910  | 27.1405  | 25.7507  | 22.5991  | 21.8794  | 23.0965  | 23.7323  | 27.1845            | 29.7826  | 33.9085   | (46)        |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                    |          |           |             |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000   | 0.0000    | (56)        |
| If cylinder contains dedicated solar storage                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000   | 0.0000    | (57)        |
| Primary loss                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000   | 0.0000    | (59)        |
| Combi loss                                                      | 2.5528   | 2.3647   | 2.6361   | 2.4472   | 2.4735   | 2.3138   | 2.2934   | 2.3113   | 2.2561   | 2.4036             | 2.4141   | 2.5334    | (61)        |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|                                                                 | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337           | 200.9648 | 228.5900  | (62)        |
| WWHRS                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000   | 0.0000    | (63a)       |
| PV diverter                                                     | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000            | -0.0000  | -0.0000   | (63b)       |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000   | 0.0000    | (63c)       |
| FGHRS                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000   | 0.0000    | (63d)       |

# Full SAP Calculation Printout



|                                          |                                                                                |          |          |          |          |          |          |          |          |          |          |                |
|------------------------------------------|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Output from w/h                          | 231.8023                                                                       | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337 | 200.9648 | 228.5900 (64)  |
|                                          | Total per year (kWh/year) = Sum(64)m =                                         |          |          |          |          |          |          |          |          |          |          | 2239.0711 (64) |
| Electric shower(s)                       | 0.0000                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (64a)   |
|                                          | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |          | 0.0000 (64a)   |
| Heat gains from water heating, kWh/month | 76.8636                                                                        | 67.6635  | 71.1291  | 60.7732  | 57.6991  | 50.6731  | 49.0727  | 51.7750  | 53.1706  | 60.8599  | 66.6216  | 75.7972 (65)   |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 33.0002   | 29.3105   | 23.8369   | 18.0461   | 13.4897   | 11.3885   | 12.3057   | 15.9954   | 21.4690   | 27.2599   | 31.8163   | 33.9174   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 396.0188  | 400.1283  | 389.7726  | 367.7267  | 339.8976  | 313.7422  | 296.2688  | 292.1594  | 302.5151  | 324.5610  | 352.3901  | 378.5454  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | (71) |
| Water heating gains (Table 5)                                                       | 103.3114  | 100.6898  | 95.6036   | 84.4072   | 77.5525   | 70.3794   | 65.9580   | 69.5900   | 73.8480   | 81.8009   | 92.5301   | 101.8779  | (72) |
| Total internal gains                                                                | 645.5769  | 643.3750  | 622.4597  | 583.4264  | 544.1863  | 505.7566  | 484.7790  | 487.9913  | 508.0786  | 546.8683  | 589.9829  | 627.5872  | (73) |

## 6. Solar gains

| [Jan]       |          |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |      |
|-------------|----------|----------|----------|-----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|------|
| North       |          |          |          |           | 1.4200     | 10.6334                        |           | 0.7300                            | 0.7000                             | 0.7700                       |          | 5.3471 (74)  |      |
| East        |          |          |          |           | 7.2100     | 19.6403                        |           | 0.7300                            | 0.7000                             | 0.7700                       |          | 50.1460 (76) |      |
| West        |          |          |          |           | 7.0000     | 19.6403                        |           | 0.7300                            | 0.7000                             | 0.7700                       |          | 48.6855 (80) |      |
|             |          |          |          |           |            |                                |           |                                   |                                    |                              |          |              |      |
| Solar gains | 104.1786 | 203.5539 | 335.7596 | 492.2521  | 606.6636   | 622.7884                       | 592.1794  | 506.2095                          | 391.1845                           | 241.5726                     | 129.8276 | 85.7318      | (83) |
| Total gains | 749.7555 | 846.9290 | 958.2193 | 1075.6785 | 1150.8499  | 1128.5450                      | 1076.9584 | 994.2008                          | 899.2630                           | 788.4409                     | 719.8105 | 713.3190     | (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 67.0625                   | 67.2913 | 67.5170 | 68.5980 | 68.8041 | 69.7800 | 69.7800 | 69.9638 | 69.4008 | 68.8041 | 68.3884 | 67.9592      |
| alpha                                                                       | 5.4708                    | 5.4861  | 5.5011  | 5.5732  | 5.5869  | 5.6520  | 5.6520  | 5.6643  | 5.6267  | 5.5869  | 5.5592  | 5.5306       |
| util living area                                                            | 0.9977                    | 0.9951  | 0.9858  | 0.9490  | 0.8453  | 0.6592  | 0.4904  | 0.5500  | 0.8192  | 0.9731  | 0.9954  | 0.9983 (86)  |
| MIT                                                                         | 20.5247                   | 20.5649 | 20.6347 | 20.7267 | 20.7950 | 20.8281 | 20.8342 | 20.8336 | 20.8110 | 20.7180 | 20.6065 | 20.5211 (87) |
| Th 2                                                                        | 19.9261                   | 19.9294 | 19.9325 | 19.9476 | 19.9504 | 19.9635 | 19.9635 | 19.9659 | 19.9584 | 19.9504 | 19.9447 | 19.9387 (88) |
| util rest of house                                                          | 0.9969                    | 0.9932  | 0.9800  | 0.9284  | 0.7899  | 0.5649  | 0.3776  | 0.4314  | 0.7369  | 0.9583  | 0.9933  | 0.9976 (89)  |
| MIT 2                                                                       | 19.3551                   | 19.4094 | 19.5008 | 19.6280 | 19.7062 | 19.7486 | 19.7519 | 19.7545 | 19.7313 | 19.6225 | 19.4770 | 19.3623 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         | 0.1677 (91)  |
| MIT                                                                         | 19.5513                   | 19.6032 | 19.6910 | 19.8123 | 19.8888 | 19.9296 | 19.9334 | 19.9354 | 19.9124 | 19.8062 | 19.6665 | 19.5567 (92) |
| Temperature adjustment                                                      |                           |         |         |         |         |         |         |         |         |         |         | -0.1500      |
| adjusted MIT                                                                | 19.4013                   | 19.4532 | 19.5410 | 19.6623 | 19.7388 | 19.7796 | 19.7834 | 19.7854 | 19.7624 | 19.6562 | 19.5165 | 19.4067 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |           |           |               |              |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|-----------|-----------|---------------|--------------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec           |              |
| Useful gains                                                                   | 0.9963    | 0.9921    | 0.9773    | 0.9215    | 0.7769   | 0.5471   | 0.3576   | 0.4101   | 0.7187   | 0.9527    | 0.9921    | 0.9972        | (94)         |
| Ext temp.                                                                      | 746.9777  | 840.2274  | 936.4880  | 991.2024  | 894.0686 | 617.4684 | 385.0996 | 407.6762 | 646.3163 | 751.1155  | 714.1054  | 711.3010      | (95)         |
| Heat loss rate W                                                               | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000   | 7.1000    | 4.2000        | (96)         |
| Space heating kWh                                                              | 1904.5374 | 1829.1706 | 1633.6252 | 1326.9349 | 988.1686 | 627.8019 | 385.8489 | 409.2588 | 690.0672 | 1113.2410 | 1535.5734 | 1892.5217     | (97)         |
| Space heating requirement - total per year (kWh/year)                          | 861.2244  | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214  | 591.4570  | 878.8282      | (98a)        |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000        | (98b)        |
| Solar heating contribution - total per year (kWh/year)                         | 861.2244  | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214  | 591.4570  | 878.8282      | (98c)        |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |           |           | 4095.9088     |              |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          |           |           | (98c) / (4) = | 38.7247 (99) |

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

|                                                                       |          |          |          |          |         |        |        |        |        |          |          |               |       |
|-----------------------------------------------------------------------|----------|----------|----------|----------|---------|--------|--------|--------|--------|----------|----------|---------------|-------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |         |        |        |        |        |          |          | 0.0000 (201)  |       |
| Fraction of space heat from main system(s)                            |          |          |          |          |         |        |        |        |        |          |          | 1.0000 (202)  |       |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |         |        |        |        |        |          |          | 88.6000 (206) |       |
| Efficiency of main space heating system 2 (in %)                      |          |          |          |          |         |        |        |        |        |          |          | 0.0000 (207)  |       |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |         |        |        |        |        |          |          | 0.0000 (208)  |       |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May     | Jun    | Jul    | Aug    | Sep    | Oct      | Nov      | Dec           |       |
| Space heating requirement                                             | 861.2244 | 664.5699 | 518.6701 | 241.7274 | 70.0104 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 269.4214 | 591.4570 | 878.8282      | (98)  |
| Space heating efficiency (main heating system 1)                      | 88.6000  | 88.6000  | 88.6000  | 88.6000  | 88.6000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.6000  | 88.6000  | 88.6000       | (210) |
| Space heating fuel (main heating system)                              |          |          |          |          |         |        |        |        |        |          |          |               |       |

# Full SAP Calculation Printout



|                                                                                                      |          |          |          |           |           |           |           |           |           |          |            |        |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|------------|--------|
| 972.0366                                                                                             | 750.0789 | 585.4065 | 272.8301 | 79.0185   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 304.0873  | 667.5587 | 991.9054   | (211)  |
| Space heating efficiency (main heating system 2)                                                     |          |          |          |           |           |           |           |           |           |          |            |        |
| 0.0000                                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (212)  |
| Space heating fuel (main heating system 2)                                                           |          |          |          |           |           |           |           |           |           |          |            |        |
| 0.0000                                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (213)  |
| Space heating fuel (secondary)                                                                       |          |          |          |           |           |           |           |           |           |          |            |        |
| 0.0000                                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (215)  |
| Water heating                                                                                        |          |          |          |           |           |           |           |           |           |          |            |        |
| Water heating requirement                                                                            |          |          |          |           |           |           |           |           |           |          |            |        |
| 231.8023                                                                                             | 204.0860 | 214.5762 | 183.3837 | 174.1448  | 152.9745  | 148.1562  | 156.2877  | 160.4713  | 183.6337  | 200.9648 | 228.5900   | (64)   |
| Efficiency of water heater                                                                           |          |          |          |           |           |           |           |           |           |          |            |        |
| (217)m                                                                                               | 86.5253  | 86.3073  | 85.7624  | 84.4796   | 81.9881   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 84.7176  | 86.1303    | (216)  |
| Fuel for water heating, kWh/month                                                                    |          |          |          |           |           |           |           |           |           |          |            |        |
| 267.9012                                                                                             | 236.4643 | 250.1986 | 217.0745 | 212.4025  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 216.7599  | 233.3266 | 264.0236   | (219)  |
| Space cooling fuel requirement                                                                       |          |          |          |           |           |           |           |           |           |          |            |        |
| (221)m                                                                                               | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (221)  |
| Pumps and Fa                                                                                         |          |          |          |           |           |           |           |           |           |          |            |        |
| 7.3041                                                                                               | 6.5973   | 7.3041   | 7.0685   | 7.3041    | 7.0685    | 7.3041    | 7.3041    | 7.3041    | 7.0685    | 7.3041   | 7.0685     | (231)  |
| Lighting                                                                                             |          |          |          |           |           |           |           |           |           |          |            |        |
| 28.8849                                                                                              | 23.1726  | 20.8643  | 15.2861  | 11.8074   | 9.6468    | 10.7711   | 14.0007   | 18.1855   | 23.8604   | 26.9503  | 29.6877    | (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |            |        |
| (233a)m                                                                                              | -33.0601 | -51.3704 | -81.6378 | -98.5308  | -109.6129 | -103.2046 | -101.4318 | -93.7910  | -79.9001  | -61.4567 | -37.5969   | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |            |        |
| (234a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |            |        |
| (235a)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |            |        |
| (235c)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |           |           |           |           |           |           |          |            |        |
| (233b)m                                                                                              | -14.9249 | -36.2530 | -85.9866 | -150.0681 | -216.2967 | -224.4244 | -218.8576 | -173.8982 | -112.6673 | -55.7180 | -20.8495   | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              |          |          |          |           |           |           |           |           |           |          |            |        |
| (234b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  |          |          |          |           |           |           |           |           |           |          |            |        |
| (235b)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) |          |          |          |           |           |           |           |           |           |          |            |        |
| (235d)m                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000     | (235d) |
| Annual totals kWh/year                                                                               |          |          |          |           |           |           |           |           |           |          |            |        |
| Space heating fuel - main system 1                                                                   |          |          |          |           |           |           |           |           |           |          | 4622.9219  | (211)  |
| Space heating fuel - main system 2                                                                   |          |          |          |           |           |           |           |           |           |          | 0.0000     | (213)  |
| Space heating fuel - secondary                                                                       |          |          |          |           |           |           |           |           |           |          | 0.0000     | (215)  |
| Efficiency of water heater                                                                           |          |          |          |           |           |           |           |           |           |          | 79.6000    |        |
| Water heating fuel used                                                                              |          |          |          |           |           |           |           |           |           |          | 2674.3945  | (219)  |
| Space cooling fuel                                                                                   |          |          |          |           |           |           |           |           |           |          | 0.0000     | (221)  |
| Electricity for pumps and fans:                                                                      |          |          |          |           |           |           |           |           |           |          |            |        |
| central heating pump                                                                                 |          |          |          |           |           |           |           |           |           |          | 41.0000    | (230c) |
| main heating flue fan                                                                                |          |          |          |           |           |           |           |           |           |          | 45.0000    | (230e) |
| Total electricity for the above, kWh/year                                                            |          |          |          |           |           |           |           |           |           |          | 86.0000    | (231)  |
| Electricity for lighting (calculated in Appendix L)                                                  |          |          |          |           |           |           |           |           |           |          | 233.1179   | (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |          |           |           |           |           |           |           |          |            |        |
| PV generation                                                                                        |          |          |          |           |           |           |           |           |           |          | -2200.6387 | (233)  |
| Wind generation                                                                                      |          |          |          |           |           |           |           |           |           |          | 0.0000     | (234)  |
| Hydro-electric generation (Appendix N)                                                               |          |          |          |           |           |           |           |           |           |          | 0.0000     | (235a) |
| Electricity generated - Micro CHP (Appendix N)                                                       |          |          |          |           |           |           |           |           |           |          | 0.0000     | (235)  |
| Appendix Q - special features                                                                        |          |          |          |           |           |           |           |           |           |          |            |        |
| Energy saved or generated                                                                            |          |          |          |           |           |           |           |           |           |          | -0.0000    | (236)  |
| Energy used                                                                                          |          |          |          |           |           |           |           |           |           |          | 0.0000     | (237)  |
| Total delivered energy for all uses                                                                  |          |          |          |           |           |           |           |           |           |          | 5415.7956  | (238)  |

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

|                                             | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1               | 4622.9219        | 3.6400              | 168.2744 (240)      |
| Total CO2 associated with community systems |                  |                     | 0.0000 (473)        |
| Water heating (other fuel)                  | 2674.3945        | 3.6400              | 97.3480 (247)       |
| Energy for instantaneous electric shower(s) | 0.0000           | 16.4900             | 0.0000 (247a)       |
| Pumps, fans and electric keep-hot           | 86.0000          | 16.4900             | 14.1814 (249)       |
| Energy for lighting                         | 233.1179         | 16.4900             | 38.4411 (250)       |
| Additional standing charges                 |                  |                     | 92.0000 (251)       |
| Energy saving/generation technologies       |                  |                     |                     |
| PV Unit electricity used in dwelling        | -879.3767        | 16.4900             | -145.0092           |
| PV Unit electricity exported                | -1321.2619       | 5.5900              | -73.8585            |
| Total                                       |                  |                     | -218.8678 (252)     |
| Total energy cost                           |                  |                     | 191.3771 (255)      |

## 11a. SAP rating - Individual heating systems

|                                  |              |
|----------------------------------|--------------|
| Energy cost deflator (Table 12): | 0.3600 (256) |
| Energy cost factor (ECF)         | 0.4570 (257) |
| SAP value                        | 92.5927      |
| SAP rating (Section 12)          | 93 (258)     |
| SAP band                         | A            |

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

|                                             | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1               | 4622.9219          | 0.2100                        | 970.8136 (261)           |
| Total CO2 associated with community systems |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                  | 2674.3945          | 0.2100                        | 561.6228 (264)           |
| Space and water heating                     |                    |                               | 1532.4364 (265)          |
| Pumps, fans and electric keep-hot           | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                         | 233.1179           | 0.1443                        | 33.6461 (268)            |
| Energy saving/generation technologies       |                    |                               |                          |
| PV Unit electricity used in dwelling        | -879.3767          | 0.1332                        | -117.1173                |
| PV Unit electricity exported                | -1321.2619         | 0.1223                        | -161.6557                |
| Total                                       |                    |                               | -278.7731 (269)          |
| Total CO2, kg/year                          |                    |                               | 1299.2388 (272)          |
| CO2 emissions per m2                        |                    |                               | 12.2800 (273)            |

# Full SAP Calculation Printout



EI value 88.4527  
EI rating 88 (274)  
EI band B

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

## 1. Overall dwelling characteristics

|                                                        | Area<br>(m <sup>2</sup> ) |   | Storey height<br>(m) |                                   | Volume<br>(m <sup>3</sup> ) |  |
|--------------------------------------------------------|---------------------------|---|----------------------|-----------------------------------|-----------------------------|--|
| Ground floor                                           | 25.4100 (1b)              | x | 2.8400 (2b)          | =                                 | 72.1644 (1b) - (3b)         |  |
| First floor                                            | 40.1800 (1c)              | x | 2.3900 (2c)          | =                                 | 96.0302 (1c) - (3c)         |  |
| Second floor                                           | 40.1800 (1d)              | x | 2.6000 (2d)          | =                                 | 104.4680 (1d) - (3d)        |  |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 105.7700                  |   |                      |                                   | (4)                         |  |
| Dwelling volume                                        |                           |   |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 272.6626 (5)                |  |

## 2. Ventilation rate

|                                                                                                    |          |                             |             |
|----------------------------------------------------------------------------------------------------|----------|-----------------------------|-------------|
|                                                                                                    |          | m <sup>3</sup> per hour     |             |
| Number of open chimneys                                                                            | 0 * 80 = | 0.0000 (6a)                 |             |
| Number of open flues                                                                               | 0 * 20 = | 0.0000 (6b)                 |             |
| Number of chimneys / flues attached to closed fire                                                 | 0 * 10 = | 0.0000 (6c)                 |             |
| Number of flues attached to solid fuel boiler                                                      | 0 * 20 = | 0.0000 (6d)                 |             |
| Number of flues attached to other heater                                                           | 0 * 35 = | 0.0000 (6e)                 |             |
| Number of blocked chimneys                                                                         | 0 * 20 = | 0.0000 (6f)                 |             |
| Number of intermittent extract fans                                                                | 6 * 10 = | 60.0000 (7a)                |             |
| Number of passive vents                                                                            | 0 * 10 = | 0.0000 (7b)                 |             |
| Number of flueless gas fires                                                                       | 0 * 40 = | 0.0000 (7c)                 |             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = |          | 60.0000 / (5) =             | 0.2201 (8)  |
| Pressure test                                                                                      |          | Yes                         |             |
| Pressure Test Method                                                                               |          | Blower Door                 |             |
| Measured/design AP50                                                                               |          | 4.0000 (17)                 |             |
| Infiltration rate                                                                                  |          | 0.4201 (18)                 |             |
| Number of sides sheltered                                                                          |          | 1 (19)                      |             |
| Shelter factor                                                                                     |          | (20) = 1 - [0.075 x (19)] = | 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                               |          | (21) = (18) x (20) =        | 0.3885 (21) |

|                 |        |        |        |        |        |        |        |        |        |        |        |              |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4954 | 0.4857 | 0.4760 | 0.4274 | 0.4177 | 0.3691 | 0.3691 | 0.3594 | 0.3885 | 0.4177 | 0.4371 | 0.4565 (22b) |
|                 | 0.6227 | 0.6179 | 0.6133 | 0.5913 | 0.5872 | 0.5681 | 0.5681 | 0.5646 | 0.5755 | 0.5872 | 0.5955 | 0.6042 (25)  |

## 3. Heat losses and heat loss parameter

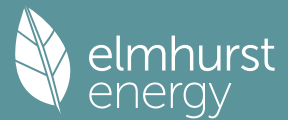
| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K    |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------|
| Solid front door                                            |                         |                            | 2.1400                    | 1.1000                        | 2.3540       |                                | (26)             |
| Windows (Uw = 1.30)                                         |                         |                            | 15.6300                   | 1.2357                        | 19.3146      |                                | (27)             |
| Ground floor                                                |                         |                            | 25.4100                   | 0.1300                        | 3.3033       | 0.0000                         | 0.0000 (28a)     |
| Exposed floor                                               |                         |                            | 14.7600                   | 0.2000                        | 2.9520       | 20.0000                        | 295.2000 (28b)   |
| Brick wall                                                  | 125.8800                | 17.7700                    | 108.1100                  | 0.1900                        | 20.5409      | 110.0000                       | 11892.1000 (29a) |
| Retaining wall                                              | 12.9200                 |                            | 12.9200                   | 0.1800                        | 2.3256       | 110.0000                       | 1421.2000 (29a)  |
| Garage wall                                                 | 21.3200                 |                            | 21.3200                   | 0.1400                        | 2.9848       | 110.0000                       | 2345.2000 (29a)  |
| Plane roof                                                  | 40.1800                 |                            | 40.1800                   | 0.0900                        | 3.6162       | 9.0000                         | 361.6200 (30)    |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 240.4700                  |                               |              |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           | (26)...(30) + (32) =          | 57.3914      |                                | (33)             |
| Party Wall 1                                                |                         |                            | 69.1400                   | 0.0000                        | 0.0000       | 140.0000                       | 9679.6000 (32)   |
| Internal Wall                                               |                         |                            | 18.2000                   |                               |              | 75.0000                        | 1365.0000 (32c)  |
| Internal Wall                                               |                         |                            | 146.3400                  |                               |              | 9.0000                         | 1317.0600 (32c)  |
| Internal Floor 1                                            |                         |                            | 65.5900                   |                               |              | 18.0000                        | 1180.6200 (32d)  |
| Internal Ceiling 1                                          |                         |                            | 65.5900                   |                               |              | 9.0000                         | 590.3100 (32e)   |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 30447.9100 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 287.8691 (35)

### List of Thermal Bridges

| K1 Element                                                       | Length  | Psi-value             | Total          |
|------------------------------------------------------------------|---------|-----------------------|----------------|
| E2 Other lintels (including other steel lintels)                 | 12.3300 | 0.0240                | 0.2959         |
| E3 Sill                                                          | 9.5000  | 0.0220                | 0.2090         |
| E4 Jamb                                                          | 30.3000 | 0.0170                | 0.5151         |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920                | 1.8575         |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010                | 0.0279         |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600                | 0.5460         |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560                | 0.4956         |
| E16 Corner (normal)                                              | 18.5000 | 0.0460                | 0.8510         |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880               | -0.4998        |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690                | 0.5513         |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200                | 2.4032         |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380                | 0.5951         |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690                | 0.6093         |
| P2 Party wall - Intermediate floor within a dwelling             | 8.8300  | 0.0000                | 0.0000         |
| P4 Party wall - Roof (insulation at ceiling level)               | 8.8300  | 0.4800                | 4.2384         |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)       |         |                       | 12.6954 (36)   |
| Point Thermal bridges                                            |         |                       | (36a) = 0.0000 |
| Total fabric heat loss                                           |         | (33) + (36) + (36a) = | 70.0868 (37)   |

# Full SAP Calculation Printout



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

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| (38)m                     | 56.0306  | 55.6019  | 55.1816  | 53.2077  | 52.8384  | 51.1191  | 51.1191  | 50.8008  | 51.7814  | 52.8384  | 53.5855  | 54.3666  | (38) |
| Heat transfer coeff       | 126.1174 | 125.6887 | 125.2684 | 123.2945 | 122.9252 | 121.2060 | 121.2060 | 120.8876 | 121.8682 | 122.9252 | 123.6723 | 124.4534 | (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 123.2927 |      |
| HLP                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| HLP (average)             | 1.1924   | 1.1883   | 1.1843   | 1.1657   | 1.1622   | 1.1459   | 1.1459   | 1.1429   | 1.1522   | 1.1622   | 1.1693   | 1.1766   | (40) |
| Days in mont              | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

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

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |          |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          |          | 2.7869 (42) |
| Hot water usage for mixer showers                                              | 70.9471  | 69.8809  | 68.3272  | 65.3546  | 63.1608  | 60.7144  | 59.3238  | 60.8657  | 62.5559  | 65.1827  | 68.2192  | 70.6752  | (42a)       |
| Hot water usage for baths                                                      | 30.6328  | 30.1778  | 29.5372  | 28.3559  | 27.4714  | 26.4907  | 25.9609  | 26.5971  | 27.2897  | 28.3392  | 29.5448  | 30.5292  | (42b)       |
| Hot water usage for other uses                                                 | 43.1707  | 41.6009  | 40.0310  | 38.4612  | 36.8913  | 35.3215  | 35.3215  | 36.8913  | 38.4612  | 40.0310  | 41.6009  | 43.1707  | (42c)       |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          | 133.0583 | (43)        |
| Daily hot water use                                                            | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |             |
| Energy conte                                                                   | 144.7505 | 141.6596 | 137.8954 | 132.1717 | 127.5236 | 122.5266 | 120.6062 | 124.3541 | 128.3069 | 133.5529 | 139.3648 | 144.3752 | (44)        |
| Energy content (annual)                                                        | 229.2495 | 201.7213 | 211.9401 | 180.9364 | 171.6713 | 150.6607 | 145.8628 | 153.9764 | 158.2152 | 181.2300 | 198.5507 | 226.0566 | (45)        |
| Distribution loss (46)m = 0.15 x (45)m                                         | 34.3874  | 30.2582  | 31.7910  | 27.1405  | 25.7507  | 22.5991  | 21.8794  | 23.0965  | 23.7323  | 27.1845  | 29.7826  | 33.9085  | (46)        |
| Water storage loss:                                                            |          |          |          |          |          |          |          |          |          |          |          |          |             |
| Total storage loss                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (56)        |
| If cylinder contains dedicated solar storage                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (57)        |
| Primary loss                                                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (59)        |
| Combi loss                                                                     | 2.5528   | 2.3647   | 2.6361   | 2.4472   | 2.4735   | 2.3138   | 2.2934   | 2.3113   | 2.2561   | 2.4036   | 2.4141   | 2.5334   | (61)        |
| Total heat required for water heating calculated for each month                | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337 | 200.9648 | 228.5900 | (62)        |
| WWHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63a)       |
| PV diverter                                                                    | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | -0.0000  | (63b)       |
| Solar input                                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63c)       |
| FGHRS                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63d)       |
| Output from w/h                                                                | 231.8023 | 204.0860 | 214.5762 | 183.3837 | 174.1448 | 152.9745 | 148.1562 | 156.2877 | 160.4713 | 183.6337 | 200.9648 | 228.5900 | (64)        |
| Electric shower(s)                                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (64a)       |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |          |          | 0.0000   | (64a)       |
| Heat gains from water heating, kWh/month                                       | 76.8636  | 67.6635  | 71.1291  | 60.7732  | 57.6991  | 50.6731  | 49.0727  | 51.7750  | 53.1706  | 60.8599  | 66.6216  | 75.7972  | (65)        |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | 167.2144  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 33.0002   | 29.3105   | 23.8369   | 18.0461   | 13.4897   | 11.3885   | 12.3057   | 15.9954   | 21.4690   | 27.2599   | 31.8163   | 33.9174   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 396.0188  | 400.1283  | 389.7726  | 367.7267  | 339.8976  | 313.7422  | 296.2688  | 292.1594  | 302.5151  | 324.5610  | 352.3901  | 378.5454  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | 54.5083   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | -111.4763 | (71) |
| Water heating gains (Table 5)                                                       | 103.3114  | 100.6898  | 95.6036   | 84.4072   | 77.5525   | 70.3794   | 65.9580   | 69.5900   | 73.8480   | 81.8009   | 92.5301   | 101.8779  | (72) |
| Total internal gains                                                                | 645.5769  | 643.3750  | 622.4597  | 583.4264  | 544.1863  | 505.7566  | 484.7790  | 487.9913  | 508.0786  | 546.8683  | 589.9829  | 627.5872  | (73) |

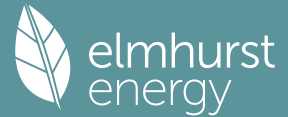
## 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |          |      |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|------|
| North       |          |          |          | 1.4200     | 10.6334                        | 0.7300                            | 0.7000                             | 0.7700                       | 5.3471 (74)  |          |          |          |      |
| East        |          |          |          | 7.2100     | 19.6403                        | 0.7300                            | 0.7000                             | 0.7700                       | 50.1460 (76) |          |          |          |      |
| West        |          |          |          | 7.0000     | 19.6403                        | 0.7300                            | 0.7000                             | 0.7700                       | 48.6855 (80) |          |          |          |      |
| Solar gains | 104.1786 | 203.5539 | 335.7596 | 492.2521   | 606.6636                       | 622.7884                          | 592.1794                           | 506.2095                     | 391.1845     | 241.5726 | 129.8276 | 85.7318  | (83) |
| Total gains | 749.7555 | 846.9290 | 958.2193 | 1075.6785  | 1150.8499                      | 1128.5450                         | 1076.9584                          | 994.2008                     | 899.2630     | 788.4409 | 719.8105 | 713.3190 | (84) |

## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |         |              |
| tau                                                                         | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| alpha                                                                       | 67.0625 | 67.2913 | 67.5170 | 68.5980 | 68.8041 | 69.7800 | 69.7800 | 69.9638 | 69.4008 | 68.8041 | 68.3884 | 67.9592 |              |
| util living area                                                            | 5.4708  | 5.4861  | 5.5011  | 5.5732  | 5.5869  | 5.6520  | 5.6520  | 5.6643  | 5.6267  | 5.5869  | 5.5592  | 5.5306  |              |
|                                                                             | 0.9977  | 0.9951  | 0.9858  | 0.9490  | 0.8453  | 0.6592  | 0.4904  | 0.5500  | 0.8192  | 0.9731  | 0.9954  | 0.9983  | (86)         |
| MIT                                                                         | 20.5247 | 20.5649 | 20.6347 | 20.7267 | 20.7950 | 20.8281 | 20.8342 | 20.8336 | 20.8110 | 20.7180 | 20.6065 | 20.5211 | (87)         |
| Th 2                                                                        | 19.9261 | 19.9294 | 19.9325 | 19.9476 | 19.9504 | 19.9635 | 19.9635 | 19.9659 | 19.9584 | 19.9504 | 19.9447 | 19.9387 | (88)         |

# Full SAP Calculation Printout



|                        |         |         |         |         |         |         |         |         |                           |         |         |              |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| util rest of house     | 0.9969  | 0.9932  | 0.9800  | 0.9284  | 0.7899  | 0.5649  | 0.3776  | 0.4314  | 0.7369                    | 0.9583  | 0.9933  | 0.9976 (89)  |
| MIT 2                  | 19.3551 | 19.4094 | 19.5008 | 19.6280 | 19.7062 | 19.7486 | 19.7519 | 19.7545 | 19.7313                   | 19.6225 | 19.4770 | 19.3623 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.1677 (91)  |
| MIT                    | 19.5513 | 19.6032 | 19.6910 | 19.8123 | 19.8888 | 19.9296 | 19.9334 | 19.9354 | 19.9124                   | 19.8062 | 19.6665 | 19.5567 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                           |         |         | -0.1500      |
| adjusted MIT           | 19.4013 | 19.4532 | 19.5410 | 19.6623 | 19.7388 | 19.7796 | 19.7834 | 19.7854 | 19.7624                   | 19.6562 | 19.5165 | 19.4067 (93) |

## 8. Space heating requirement

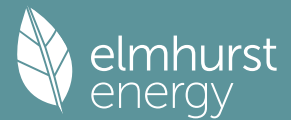
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |  |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|--|
| Utilisation                                                                    | 0.9963    | 0.9921    | 0.9773    | 0.9215    | 0.7769   | 0.5471   | 0.3576   | 0.4101   | 0.7187   | 0.9527        | 0.9921    | 0.9972 (94)    |  |
| Useful gains                                                                   | 746.9777  | 840.2274  | 936.4880  | 991.2024  | 894.0686 | 617.4684 | 385.0996 | 407.6762 | 646.3163 | 751.1155      | 714.1054  | 711.3010 (95)  |  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000       | 7.1000    | 4.2000 (96)    |  |
| Heat loss rate W                                                               | 1904.5374 | 1829.1706 | 1633.6252 | 1326.9349 | 988.1686 | 627.8019 | 385.8489 | 409.2588 | 690.0672 | 1113.2410     | 1535.5734 | 1892.5217 (97) |  |
| Space heating kWh                                                              | 861.2244  | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214      | 591.4570  | 878.8282 (98a) |  |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 4095.9088      |  |
| Solar heating kWh                                                              | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000        | 0.0000    | 0.0000 (98b)   |  |
| Solar heating contribution - total per year (kWh/year)                         |           |           |           |           |          |          |          |          |          |               |           | 0.0000         |  |
| Space heating kWh                                                              | 861.2244  | 664.5699  | 518.6701  | 241.7274  | 70.0104  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 269.4214      | 591.4570  | 878.8282 (98c) |  |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 4095.9088      |  |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 38.7247 (99)   |  |

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

| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |           |           |           |           |           |           |          |          |                  | 0.0000 (201)  |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------------|---------------|
| Fraction of space heat from main system(s)                                                           |          |          |          |           |           |           |           |           |           |          |          |                  | 1.0000 (202)  |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |           |           |           |           |           |           |          |          |                  | 88.6000 (206) |
| Efficiency of main space heating system 2 (in %)                                                     |          |          |          |           |           |           |           |           |           |          |          |                  | 0.0000 (207)  |
| Efficiency of secondary/supplementary heating system, %                                              |          |          |          |           |           |           |           |           |           |          |          |                  | 0.0000 (208)  |
|                                                                                                      | Jan      | Feb      | Mar      | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct      | Nov      | Dec              |               |
| Space heating requirement                                                                            | 861.2244 | 664.5699 | 518.6701 | 241.7274  | 70.0104   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 269.4214 | 591.4570 | 878.8282 (98)    |               |
| Space heating efficiency (main heating system 1)                                                     | 88.6000  | 88.6000  | 88.6000  | 88.6000   | 88.6000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 88.6000  | 88.6000  | 88.6000 (210)    |               |
| Space heating fuel (main heating system)                                                             | 972.0366 | 750.0789 | 585.4065 | 272.8301  | 79.0185   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 304.0873 | 667.5587 | 991.9054 (211)   |               |
| Space heating efficiency (main heating system 2)                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (212)     |               |
| Space heating fuel (main heating system 2)                                                           | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (213)     |               |
| Space heating fuel (secondary)                                                                       | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (215)     |               |
| Water heating                                                                                        |          |          |          |           |           |           |           |           |           |          |          |                  |               |
| Water heating requirement                                                                            | 231.8023 | 204.0860 | 214.5762 | 183.3837  | 174.1448  | 152.9745  | 148.1562  | 156.2877  | 160.4713  | 183.6337 | 200.9648 | 228.5900 (64)    |               |
| Efficiency of water heater                                                                           | 86.5253  | 86.3073  | 85.7624  | 84.4796   | 81.9881   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 84.7176  | 86.1303  | 86.5794 (217)    |               |
| Fuel for water heating, kWh/month                                                                    | 267.9012 | 236.4643 | 250.1986 | 217.0745  | 212.4025  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 216.7599 | 233.3266 | 264.0236 (219)   |               |
| Space cooling fuel requirement                                                                       | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (221)     |               |
| Pumps and Fa                                                                                         | 7.3041   | 6.5973   | 7.3041   | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685    | 7.3041    | 7.0685   | 7.3041   | 7.0685 (231)     |               |
| Lighting                                                                                             | 28.8849  | 23.1726  | 20.8643  | 15.2861   | 11.8074   | 9.6468    | 10.7711   | 14.0007   | 18.1855   | 23.8604  | 26.9503  | 29.6877 (232)    |               |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -33.0601 | -51.3704 | -81.6378 | -98.5308  | -109.6129 | -103.2046 | -101.4318 | -93.7910  | -79.9001  | -61.4567 | -37.5969 | -27.7837 (233a)  |               |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (234a)    |               |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235a)    |               |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235c)    |               |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -14.9249 | -36.2530 | -85.9866 | -150.0681 | -216.2967 | -224.4244 | -218.8576 | -173.8982 | -112.6673 | -55.7180 | -20.8495 | -11.3176 (233b)  |               |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (234b)    |               |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235b)    |               |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000   | 0.0000   | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000   | 0.0000   | 0.0000 (235d)    |               |
| Annual totals kWh/year                                                                               |          |          |          |           |           |           |           |           |           |          |          |                  |               |
| Space heating fuel - main system 1                                                                   |          |          |          |           |           |           |           |           |           |          |          | 4622.9219 (211)  |               |
| Space heating fuel - main system 2                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (213)     |               |
| Space heating fuel - secondary                                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (215)     |               |
| Efficiency of water heater                                                                           |          |          |          |           |           |           |           |           |           |          |          | 79.6000          |               |
| Water heating fuel used                                                                              |          |          |          |           |           |           |           |           |           |          |          | 2674.3945 (219)  |               |
| Space cooling fuel                                                                                   |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (221)     |               |
| Electricity for pumps and fans:                                                                      |          |          |          |           |           |           |           |           |           |          |          |                  |               |
| central heating pump                                                                                 |          |          |          |           |           |           |           |           |           |          |          | 41.0000 (230c)   |               |
| main heating flue fan                                                                                |          |          |          |           |           |           |           |           |           |          |          | 45.0000 (230e)   |               |
| Total electricity for the above, kWh/year                                                            |          |          |          |           |           |           |           |           |           |          |          | 86.0000 (231)    |               |
| Electricity for lighting (calculated in Appendix L)                                                  |          |          |          |           |           |           |           |           |           |          |          | 233.1179 (232)   |               |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |          |           |           |           |           |           |           |          |          |                  |               |
| PV generation                                                                                        |          |          |          |           |           |           |           |           |           |          |          | -2200.6387 (233) |               |
| Wind generation                                                                                      |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (234)     |               |
| Hydro-electric generation (Appendix N)                                                               |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (235a)    |               |
| Electricity generated - Micro CHP (Appendix N)                                                       |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (235)     |               |
| Appendix Q - special features                                                                        |          |          |          |           |           |           |           |           |           |          |          |                  |               |
| Energy saved or generated                                                                            |          |          |          |           |           |           |           |           |           |          |          | -0.0000 (236)    |               |
| Energy used                                                                                          |          |          |          |           |           |           |           |           |           |          |          | 0.0000 (237)     |               |
| Total delivered energy for all uses                                                                  |          |          |          |           |           |           |           |           |           |          |          | 5415.7956 (238)  |               |

## 10a. Fuel costs - using BEDF prices (554)

# Full SAP Calculation Printout



|                                             | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |
|---------------------------------------------|------------------|---------------------|---------------------|
| Space heating - main system 1               | 4622.9219        | 5.6000              | 258.8836 (240)      |
| Total CO2 associated with community systems |                  |                     | 0.0000 (473)        |
| Water heating (other fuel)                  | 2674.3945        | 5.6000              | 149.7661 (247)      |
| Energy for instantaneous electric shower(s) | 0.0000           | 26.0600             | 0.0000 (247a)       |
| Pumps, fans and electric keep-hot           | 86.0000          | 26.0600             | 22.4116 (249)       |
| Energy for lighting                         | 233.1179         | 26.0600             | 60.7505 (250)       |
| Additional standing charges                 |                  |                     | 99.0000 (251)       |
| Energy saving/generation technologies       |                  |                     |                     |
| PV Unit electricity used in dwelling        | -879.3767        | 26.0600             | -229.1656           |
| PV Unit electricity exported                | -1321.2619       | 5.8100              | -76.7653            |
| Total                                       |                  |                     | -305.9309 (252)     |
| Total energy cost                           |                  |                     | 284.8809 (255)      |

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

|                                             | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1               | 4622.9219          | 0.2100                        | 970.8136 (261)           |
| Total CO2 associated with community systems |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                  | 2674.3945          | 0.2100                        | 561.6228 (264)           |
| Space and water heating                     |                    |                               | 1532.4364 (265)          |
| Pumps, fans and electric keep-hot           | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                         | 233.1179           | 0.1443                        | 33.6461 (268)            |
| Energy saving/generation technologies       |                    |                               |                          |
| PV Unit electricity used in dwelling        | -879.3767          | 0.1332                        | -117.1173                |
| PV Unit electricity exported                | -1321.2619         | 0.1223                        | -161.6557                |
| Total                                       |                    |                               | -278.7731 (269)          |
| Total CO2, kg/year                          |                    |                               | 1299.2388 (272)          |

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

|                                             | Energy<br>kWh/year | Primary energy factor<br>kg CO2/kWh | Primary energy<br>kWh/year |
|---------------------------------------------|--------------------|-------------------------------------|----------------------------|
| Space heating - main system 1               | 4622.9219          | 1.1300                              | 5223.9017 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2674.3945          | 1.1300                              | 3022.0658 (278)            |
| Space and water heating                     |                    |                                     | 8245.9675 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 233.1179           | 1.5338                              | 357.5639 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -879.3767          | 1.4921                              | -1312.1603                 |
| PV Unit electricity exported                | -1321.2619         | 0.4489                              | -593.1622                  |
| Total                                       |                    |                                     | -1905.3225 (283)           |
| Total Primary energy kWh/year               |                    |                                     | 6828.3097 (286)            |

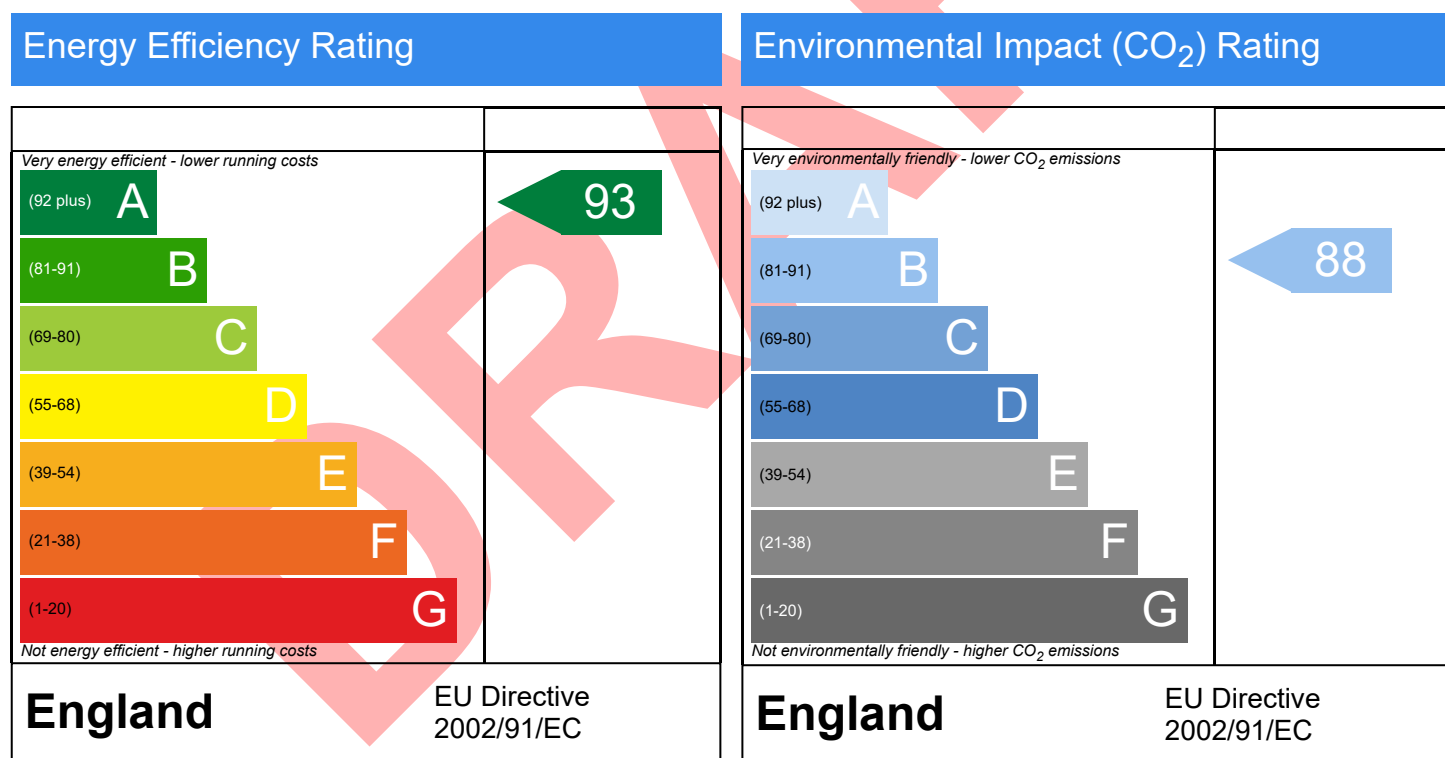
# Predicted Energy Assessment



Dwelling type: House, Semi-Detached  
Date of assessment: 15/11/2024  
Produced by: Victoria Gartside  
Total floor area: 120.53 m<sup>2</sup>  
DRRN:

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

The energy performance has been assessed using the Government approved SAP 10 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO<sub>2</sub>) emissions.



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

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