

# 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 10:34:17

| 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 46            |
| 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   | 14.52 kgCO <sub>2</sub> /m <sup>2</sup>                 |
| Dwelling carbon dioxide emission rate | 14.43 kgCO <sub>2</sub> /m <sup>2</sup> <span>OK</span> |

## 1b Target primary energy rate and dwelling primary energy

|                         |                                                         |
|-------------------------|---------------------------------------------------------|
| Target primary energy   | 76.46 kWh <sub>PE</sub> /m <sup>2</sup>                 |
| Dwelling primary energy | 76.13 kWh <sub>PE</sub> /m <sup>2</sup> <span>OK</span> |

## 1c Target fabric energy efficiency and dwelling fabric energy efficiency

|                                   |                                         |
|-----------------------------------|-----------------------------------------|
| Target fabric energy efficiency   | 51.7 kWh/m <sup>2</sup>                 |
| Dwelling fabric energy efficiency | 47.7 kWh/m <sup>2</sup> <span>OK</span> |

## 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)                        | <span>OK</span>  |
| Party walls                      | 0.2                                                    | 0                                             | Party Wall (1) (0)                      | <span>N/A</span> |
| Curtain walls                    | 1.6                                                    | 0                                             | N/A                                     | <span>N/A</span> |
| Floors                           | 0.18                                                   | 0.16                                          | Exposed floor (0.2)                     | <span>OK</span>  |
| Roofs                            | 0.16                                                   | 0.09                                          | Roof (1) (0.09)                         | <span>OK</span>  |
| Windows, doors, and roof windows | 1.6                                                    | 1.28                                          | Front windows brick (1.3)               | <span>OK</span>  |
| Rooflights                       | 2.2                                                    | N/A                                           | N/A                                     | <span>N/A</span> |

## 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                                                                                       | 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                                                                                       | 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                                                                                       | 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                                                                                       | E10: Eaves (insulation at ceiling level)                          | Calculated by person with suitable expertise     | 0.06             | MFF-150-E10-01           |
| External wall                                                                                       | E21: Exposed floor (inverted)                                     | SAP table default                                | 0.32             |                          |
| 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                                                                                       | E18: Party wall between dwellings                                 | Calculated by person with suitable expertise     | 0.038 (!)        | MFF-150-E18-04           |
| External wall                                                                                       | E17: Corner (inverted - internal area greater than external area) | Calculated by person with suitable expertise     | -0.088           | MFF-150-E17-01           |
| Party wall                                                                                          | P1: Ground floor                                                  | Calculated by person with suitable expertise     | 0.069            | Manufacturer Declaration |
| External wall                                                                                       | E20: Exposed floor (normal)                                       | Calculated by person with suitable expertise     | 0.069            | MFF-150-E20-01           |
| 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             |                          |
| 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             |                          |
| <b>3 Air permeability (better than typically expected values are flagged with a subsequent (!))</b> |                                                                   |                                                  |                  |                          |
| 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                                                                                                       |                               |     |
| 6 Controls                                                                                                  |                               |     |
| Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services |                               |     |
| Function                                                                                                    |                               |     |
| Ecodesign class                                                                                             |                               |     |
| Manufacturer                                                                                                |                               |     |
| Model                                                                                                       |                               |     |
| Water heating - type: N/A                                                                                   |                               |     |
| Manufacturer                                                                                                |                               |     |
| Model                                                                                                       |                               |     |
| 7 Lighting                                                                                                  |                               |     |
| Minimum permitted light source efficacy                                                                     | 75 lm/W                       |     |
| Lowest light source efficacy                                                                                | 85 lm/W                       | OK  |
| External lights control                                                                                     | N/A                           |     |
| 8 Mechanical ventilation                                                                                    |                               |     |
| System type: 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                                                                                               |                               |     |
| 9 Local generation                                                                                          |                               |     |
| Technology type: Photovoltaic system (1)                                                                    |                               |     |
| 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>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                         |
| <p>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.</p> |                                         |
| <p>Signed:</p><br><br><p>Name:</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <p>Assessor ID:</p><br><br><p>Date:</p> |
| <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 46        | Prop Type Ref | SAP VG 21-0282 |            |
| Property             |                |               |                |            |

|                                    |          |               |       |      |       |
|------------------------------------|----------|---------------|-------|------|-------|
| SAP Rating                         | 91 B     | DER           | 14.43 | TER  | 14.52 |
| Environmental                      | 87 B     | % DER < TER   |       |      | 0.62  |
| CO <sub>2</sub> Emissions (t/year) | 1.47     | DFEE          | 47.74 | TFEE | 51.67 |
| Compliance Check                   | See BREL | % DFEE < TFEE |       |      | 7.60  |
| % DPER < TPER                      | 0.43     | DPER          | 76.13 | TPER | 76.46 |

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

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

|                                |                            |
|--------------------------------|----------------------------|
| Orientation                    | West                       |
| Property Tenture               | 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       |
| 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       |
| 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       |
| 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       |
| E10 Eaves (insulation at ceiling level)                          | Independently assessed | 9.10   | 0.06  | 0.06     | MFF-150-E10-01           | No       |
| E21 Exposed floor (inverted)                                     | Table K1 - Default     | 7.51   | 0.32  | 0.32     |                          | 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       |
| E18 Party wall between dwellings                                 | Independently assessed | 15.66  | 0.04  | 0.04     | MFF-150-E18-04           | No       |
| E17 Corner (inverted – internal area greater than external area) | Independently assessed | 5.68   | -0.09 | -0.09    | MFF-150-E17-01           | No       |
| P1 Party wall - Ground floor                                     | Independently assessed | 8.83   | 0.07  | 0.07     | Manufacturer Declaration | No       |
| E20 Exposed floor (normal)                                       | Independently assessed | 7.99   | 0.07  | 0.07     | MFF-150-E20-01           | 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       |
| 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

# Summary for Input Data

|                                                  |   |
|--------------------------------------------------|---|
| Number of chimneys/flues attached to closed fire | 0 |
| Number of flues attached to solid fuel boiler    | 0 |
| Number of flues attached to other heater         | 0 |
| Number of blocked chimneys                       | 0 |
| Number of intermittent extract fans              | 6 |
| Number of passive vents                          | 0 |
| Number of flueless gas fires                     | 0 |

**21.0 Fixed Cooling System**

**22.0 Pressure Testing**

|                           |             |                                             |
|---------------------------|-------------|---------------------------------------------|
| Designed AP <sub>50</sub> | 4.00        | m <sup>2</sup> /(h.m <sup>2</sup> ) @ 50 Pa |
| Property Tested?          | Yes         |                                             |
| Test Method               | Blower Door |                                             |

**22.0 Lighting**

|                   |             |                 |              |                 |              |
|-------------------|-------------|-----------------|--------------|-----------------|--------------|
| No Fixed Lighting |             |                 |              |                 |              |
|                   | <b>Name</b> | <b>Efficacy</b> | <b>Power</b> | <b>Capacity</b> | <b>Count</b> |
|                   | Lighting 1  | 85.00           | 10.00        | 850.00          | 25           |

**24.0 Main Heating 1**

Percentage of Heat  %

Database Ref. No.

Fuel Type

SAP Code

In Winter

In Summer

Model Name

Manufacturer

System Type

Controls SAP Code

Delayed Start Stat

Burner Control

HETAS approved System

Flue Type

Fan Assisted Flue

Is MHS Pumped

Heating Pump Age

Heat Emitter

Underfloor Heating

Flow Temperature

Boiler Interlock

Combi boiler type

**25.0 Main Heating 2**

**26.0 Heat Networks**

|               | Heat Source | Fuel Type | Heating Use | Efficiency | Percentage Of Heat | Heat | Heat Power Ratio | Electrical | Fuel Factor | Efficiency type |
|---------------|-------------|-----------|-------------|------------|--------------------|------|------------------|------------|-------------|-----------------|
| Heat source 1 | None        |           |             |            |                    |      |                  |            |             |                 |
| Heat source 2 | None        |           |             |            |                    |      |                  |            |             |                 |
| Heat source 3 | None        |           |             |            |                    |      |                  |            |             |                 |
| Heat source 4 | None        |           |             |            |                    |      |                  |            |             |                 |
| Heat source 5 | None        |           |             |            |                    |      |                  |            |             |                 |

**27.0 Secondary Heating**

# Summary for Input Data

## 28.0 Water Heating

|                                                  |                |
|--------------------------------------------------|----------------|
| Water Heating                                    | Main Heating 1 |
| SAP Code                                         | 901            |
| Flue Gas Heat Recovery System                    | No             |
| Waste Water Heat Recovery Instantaneous System 1 | No             |
| Waste Water Heat Recovery Instantaneous System 2 | No             |
| Waste Water Heat Recovery Storage System         | No             |
| Solar Panel                                      | No             |
| Water use <= 125 litres/person/day               | Yes            |
| 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 46                |               | Prop Type Ref | SAP VG 21-0282 |                |            |
| Property                           |                        |               |               |                |                |            |
|                                    |                        |               |               |                |                |            |
| SAP Rating                         | 91 B                   | DER           | 14.43         | TER            | 14.52          |            |
| Environmental                      | 87 B                   | % DER < TER   |               |                |                | 0.62       |
| CO <sub>2</sub> Emissions (t/year) | 1.47                   | DFEE          | 47.74         | TFEE           | 51.67          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |               |                |                | 7.60       |
| % DPER < TPER                      | 0.43                   | DPER          | 76.13         | TPER           | 76.46          |            |
|                                    |                        |               |               |                |                |            |
| 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

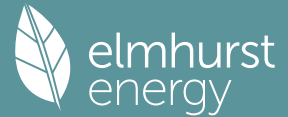
|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of 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                                                       |         |                       |              |
| 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       |
| E4 Jamb                                                          | 30.3000 | 0.0170                | 0.5151       |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920                | 1.8575       |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920                | 1.8575       |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010                | 0.0279       |
| 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       |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600                | 0.5460       |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200                | 2.4032       |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560                | 0.4956       |
| E16 Corner (normal)                                              | 18.5000 | 0.0460                | 0.8510       |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380                | 0.5951       |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880               | -0.4998      |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690                | 0.6093       |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690                | 0.5513       |
| 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       |
| 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)       |         |                       | 24.8859 (36) |
| Point Thermal bridges                                            |         | (36a) =               | 0.0000       |
| Total fabric heat loss                                           |         | (33) + (36) + (36a) = | 82.2773 (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       | 138.3079 | 137.8792 | 137.4589 | 135.4850 | 135.1157 | 133.3964 | 133.3964 | 133.0781 | 134.0587 | 135.1157 | 135.8628 | 136.6439 | (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 135.4832 |      |
| HLP                       | 1.3076   | 1.3036   | 1.2996   | 1.2809   | 1.2774   | 1.2612   | 1.2612   | 1.2582   | 1.2675   | 1.2774   | 1.2845   | 1.2919   | (40) |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.2809   |      |
| Days in mont              | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

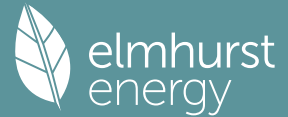
## 4. Water heating energy requirements (kWh/year)

|                                                                 |          |          |          |          |          |          |          |          |          |                                                                                |          |           |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------------------------------------------------------------------|----------|-----------|-------------|
| 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                                                    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| (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) |

# Full SAP Calculation Printout



## 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 | 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                                                                         | 61.1516 | 61.3418 | 61.5293 | 62.4258 | 62.5964 | 63.4031 | 63.4031 | 63.5548 | 63.0899 | 62.5964 | 62.2522 | 61.8963 |      |
| alpha                                                                       | 5.0768  | 5.0895  | 5.1020  | 5.1617  | 5.1731  | 5.2269  | 5.2269  | 5.2370  | 5.2060  | 5.1731  | 5.1501  | 5.1264  |      |
| util living area                                                            | 0.9986  | 0.9965  | 0.9903  | 0.9632  | 0.8816  | 0.7109  | 0.5406  | 0.6045  | 0.8594  | 0.9814  | 0.9968  | 0.9989  | (86) |
| MIT                                                                         | 20.4577 | 20.5027 | 20.5749 | 20.6781 | 20.7609 | 20.8085 | 20.8194 | 20.8178 | 20.7838 | 20.6721 | 20.5499 | 20.4548 | (87) |
| Th 2                                                                        | 19.8349 | 19.8380 | 19.8411 | 19.8558 | 19.8585 | 19.8714 | 19.8714 | 19.8737 | 19.8664 | 19.8585 | 19.8530 | 19.8472 | (88) |
| util rest of house                                                          | 0.9980  | 0.9951  | 0.9862  | 0.9467  | 0.8306  | 0.6085  | 0.4081  | 0.4676  | 0.7805  | 0.9703  | 0.9953  | 0.9984  | (89) |
| MIT 2                                                                       | 19.1845 | 19.2450 | 19.3398 | 19.4819 | 19.5794 | 19.6360 | 19.6424 | 19.6445 | 19.6125 | 19.4792 | 19.3193 | 19.1922 | (90) |
| Living area fraction                                                        | 19.3981 | 19.4559 | 19.5469 | 19.6826 | 19.7776 | 19.8327 | 19.8398 | 19.8413 | 19.8090 | 19.6793 | 19.5257 | 19.4039 | (91) |
| MIT                                                                         | 19.3981 | 19.4559 | 19.5469 | 19.6826 | 19.7776 | 19.8327 | 19.8398 | 19.8413 | 19.8090 | 19.6793 | 19.5257 | 19.4039 | (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | -0.1500 |      |
| adjusted MIT                                                                | 19.2481 | 19.3059 | 19.3969 | 19.5326 | 19.6276 | 19.6827 | 19.6898 | 19.6913 | 19.6590 | 19.5293 | 19.3757 | 19.2539 | (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |               |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|-----------|-----------|-------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec       |       |
| Utilisation                                                                    | 0.9976    | 0.9942    | 0.9841    | 0.9407    | 0.8181    | 0.5896   | 0.3859   | 0.4440   | 0.7625   | 0.9657        | 0.9944    | 0.9981    | (94)  |
| Useful gains                                                                   | 680.8947  | 792.6561  | 887.8786  | 976.0133  | 917.6281  | 657.3310 | 410.3831 | 434.3794 | 670.3675 | 724.8350      | 669.1514  | 649.7341  | (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                                                               | 2067.4342 | 1986.2760 | 1772.7961 | 1440.5516 | 1071.1381 | 678.0118 | 412.1692 | 438.0011 | 745.2255 | 1206.4883     | 1667.8152 | 2057.0267 | (97)  |
| Space heating kWh                                                              | 1031.5854 | 802.1125  | 658.3786  | 334.4676  | 114.2114  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 358.3501      | 719.0380  | 1047.0256 | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |               |           | 5065.1692 |       |
| 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                                                              | 1031.5854 | 802.1125  | 658.3786  | 334.4676  | 114.2114  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 358.3501      | 719.0380  | 1047.0256 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |               |           | 5065.1692 |       |
| Space heating per m <sup>2</sup>                                               |           |           |           |           |           |          |          |          |          | (98c) / (4) = |           | 47.8885   | (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                                                                            | 1031.5854 | 802.1125 | 658.3786 | 334.4676  | 114.2114  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 358.3501 | 719.0380 | 1047.0256 | (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)                                                             | 1164.3176 | 905.3189 | 743.0910 | 377.5029  | 128.9068  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 404.4584 | 811.5553 | 1181.7445 | (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 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                                                                    | 86.7994   | 86.6137  | 86.2042  | 85.1891   | 82.9368   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 85.3311  | 86.4645  | 79.6000   | (216)  |
| Fuel for water heating, kWh/month                                                                    | 267.0553  | 235.6279 | 248.9161 | 215.2666  | 209.9728  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 215.2014 | 232.4247 | 263.2297  | (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)                                        | -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)                              |           |          |          |           |           |           |           |           |           |          |          |           |        |

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|                                                                                                      |        |        |        |        |        |        |        |        |        |        |        |            |        |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|--------|
| (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                                                                   |        |        |        |        |        |        |        |        |        |        |        | 5716.8953  | (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                                                                              |        |        |        |        |        |        |        |        |        |        |        | 2663.9377  | (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                                                                  |        |        |        |        |        |        |        |        |        |        |        | 6499.3122  | (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                   | 5716.8953          | 0.2100                        | 1200.5480                | (261) |
| Total CO2 associated with community systems     |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                      | 2663.9377          | 0.2100                        | 559.4269                 | (264) |
| Space and water heating                         |                    |                               | 1759.9749                | (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                              |                    |                               | 1526.7772                | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 14.4300                  | (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               | 5716.8953          | 1.1300                              | 6460.0917                  | (275) |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473) |
| Water heating (other fuel)                  | 2663.9377          | 1.1300                              | 3010.2496                  | (278) |
| Space and water heating                     |                    |                                     | 9470.3413                  | (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               |                    |                                     | 8052.6835                  | (286) |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 76.1300                    | (287) |

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

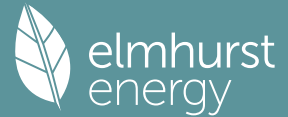
### 1. Overall dwelling characteristics

|                                                          | 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                | 4 * 10 =    | 40.0000 (7a) |
| Number of passive vents                            | 0 * 10 =    | 0.0000 (7b)  |

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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) =  
Pressure test  
Pressure Test Method  
Measured/design AP50  
Infiltration rate  
Number of sides sheltered

Air changes per hour  
40.0000 / (5) = 0.1467 (8)  
Yes  
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 |        |        |        |        |        |        |        |        |        |        |        |              |
| 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  |
| E4 Jamb                                                          | 30.3000 | 0.0500    | 1.5150  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.1600    | 3.2304  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.1600    | 3.2304  |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0000    | 0.0000  |
| 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  |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460  |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032  |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0600    | 0.5310  |
| E16 Corner (normal)                                              | 18.5000 | 0.0900    | 1.6650  |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0600    | 0.9396  |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0900   | -0.5112 |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0800    | 0.7064  |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.3200    | 2.5568  |
| 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  |
| 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)

30.3751 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 85.6769 (37)

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

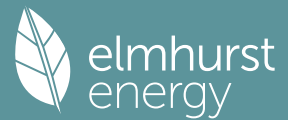
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (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       | 140.5141 | 140.1317 | 139.7569 | 137.9963 | 137.6669 | 136.1335 | 136.1335 | 135.8495 | 136.7242 | 137.6669 | 138.3333 | 139.0299 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 137.9947      |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.3285 | 1.3249 | 1.3213 | 1.3047 | 1.3016 | 1.2871 | 1.2871 | 1.2844 | 1.2927 | 1.3016 | 1.3079 | 1.3145 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.3047      |
| 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) |
| 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                       |                    |          |          |          |          |          |          |          |          |          |               |               |

# Full SAP Calculation Printout



|                                                                 |                                        |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| 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 (56)    |
| 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                                                      | 50.9589                                | 46.0274  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589  | 50.9589  | 49.3151  | 50.9589  | 49.3151  | 50.9589 (59)   |
| 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)   |
| 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)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| 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)                                                       | 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)

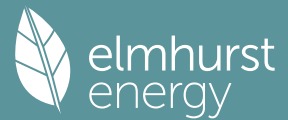
|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| 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                                                                         | 60.1915 | 60.3557 | 60.5176 | 61.2897 | 61.4364 | 62.1284 | 62.1284 | 62.2582 | 61.8600 | 61.4364 | 61.1404 | 60.8340 |              |
| alpha                                                                       | 5.0128  | 5.0237  | 5.0345  | 5.0860  | 5.0958  | 5.1419  | 5.1419  | 5.1505  | 5.1240  | 5.0958  | 5.0760  | 5.0556  |              |
| util living area                                                            | 0.9985  | 0.9967  | 0.9918  | 0.9707  | 0.9053  | 0.7524  | 0.5817  | 0.6435  | 0.8804  | 0.9836  | 0.9969  | 0.9988  | (86)         |
| MIT                                                                         | 19.5372 | 19.7036 | 19.9775 | 20.3711 | 20.7126 | 20.9253 | 20.9840 | 20.9739 | 20.8211 | 20.3728 | 19.8938 | 19.5182 | (87)         |
| Th 2                                                                        | 19.8186 | 19.8214 | 19.8242 | 19.8372 | 19.8396 | 19.8510 | 19.8510 | 19.8531 | 19.8466 | 19.8396 | 19.8347 | 19.8295 | (88)         |
| util rest of house                                                          | 0.9979  | 0.9954  | 0.9882  | 0.9570  | 0.8601  | 0.6497  | 0.4394  | 0.4993  | 0.8065  | 0.9734  | 0.9954  | 0.9984  | (89)         |
| MIT 2                                                                       | 18.1285 | 18.3432 | 18.6943 | 19.1966 | 19.5979 | 19.8108 | 19.8467 | 19.8450 | 19.7255 | 19.2075 | 18.5966 | 18.1118 | (90)         |
| Living area fraction                                                        | 18.3648 | 18.5714 | 18.9095 | 19.3936 | 19.7849 | 19.9977 | 20.0374 | 20.0343 | 19.9092 | 19.4029 | 18.8142 | 18.3477 | (91)         |
| MIT                                                                         | 18.3648 | 18.5714 | 18.9095 | 19.3936 | 19.7849 | 19.9977 | 20.0374 | 20.0343 | 19.9092 | 19.4029 | 18.8142 | 18.3477 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.3648 | 18.5714 | 18.9095 | 19.3936 | 19.7849 | 19.9977 | 20.0374 | 20.0343 | 19.9092 | 19.4029 | 18.8142 | 18.3477 | (93)         |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |           |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |       |
| Useful gains                                                                   | 0.9968    | 0.9933    | 0.9841    | 0.9499    | 0.8575    | 0.6642   | 0.4635   | 0.5236   | 0.8114   | 0.9679    | 0.9933    | 0.9974    | (94)  |
| Ext temp.                                                                      | 682.3335  | 780.3291  | 858.6134  | 936.9466  | 904.5785  | 694.6207 | 462.8550 | 484.4671 | 683.1286 | 710.2136  | 666.8992  | 653.7921  | (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                                                              | 1976.2970 | 1915.7939 | 1734.3116 | 1448.0753 | 1113.0178 | 734.8079 | 467.9496 | 493.7242 | 794.2641 | 1211.8691 | 1620.4657 | 1966.9500 | (97)  |
| Space heating requirement - total per year (kWh/year)                          | 962.7088  | 763.0323  | 651.5194  | 368.0127  | 155.0789  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 373.2317  | 686.5679  | 976.9895  | (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)                         | 962.7088  | 763.0323  | 651.5194  | 368.0127  | 155.0789  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 373.2317  | 686.5679  | 976.9895  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |           | 4937.1412 |       |
| Space heating per m <sup>2</sup>                                               |           |           |           |           |           |          |          |          |          |           |           | 46.6781   | (99)  |

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

# Full SAP Calculation Printout



|                                                                                                      |           |          |          |           |           |           |           |           |           |          |          |                  |
|------------------------------------------------------------------------------------------------------|-----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------------|
| 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                                                                            | 962.7088  | 763.0323 | 651.5194 | 368.0127  | 155.0789  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 373.2317 | 686.5679 | 976.9895 (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)                                                             | 1041.8927 | 825.7925 | 705.1076 | 398.2822  | 167.8343  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 403.9304 | 743.0388 | 1057.3479 (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                                                                           | 86.9929   | 86.8258  | 86.4618  | 85.6157   | 83.8481   | 80.3000   | 80.3000   | 80.3000   | 80.3000   | 85.6186  | 86.6446  | 80.3000 (216)    |
| Fuel for water heating, kWh/month                                                                    | 284.8212  | 252.3026 | 269.3233 | 239.8853  | 237.8712  | 224.3345  | 221.9545  | 230.5907  | 232.8868  | 242.9327 | 254.4391 | 87.0301 (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    | 7.0685    | 7.3041    | 7.0685   | 7.3041   | 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                                                                   |           |          |          |           |           |           |           |           |           |          |          | 5343.2265 (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                                                                              |           |          |          |           |           |           |           |           |           |          |          | 2973.0627 (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                                                                  |           |          |          |           |           |           |           |           |           |          |          | 6654.7684 (238)  |

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

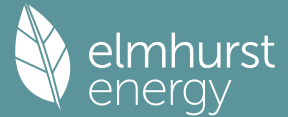
|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 5343.2265          | 0.2100                        | 1122.0776 (261)          |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2973.0627          | 0.2100                        | 624.3432 (264)           |
| Space and water heating                       |                    |                               | 1746.4207 (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                            |                    |                               | 1535.6629 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 14.5200 (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               | 5343.2265          | 1.1300                              | 6037.8459 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2973.0627          | 1.1300                              | 3359.5609 (278)            |
| Space and water heating                     |                    |                                     | 9397.4068 (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               |                    |                                     | 8087.6323 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 76.4600 (287)              |



# Full SAP Calculation Printout



|                                    |                        |               |       |               |                |            |  |
|------------------------------------|------------------------|---------------|-------|---------------|----------------|------------|--|
| Property Reference                 | SAP VG 21-0282         |               |       |               | Issued on Date | 15/11/2024 |  |
| Assessment Reference               | Plot 46                |               |       | Prop Type Ref | SAP VG 21-0282 |            |  |
| Property                           |                        |               |       |               |                |            |  |
|                                    |                        |               |       |               |                |            |  |
| SAP Rating                         | 91 B                   | DER           | 14.43 | TER           | 14.52          |            |  |
| Environmental                      | 87 B                   | % DER < TER   |       |               |                | 0.62       |  |
| CO <sub>2</sub> Emissions (t/year) | 1.47                   | DFEE          | 47.74 | TFEE          | 51.67          |            |  |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |               |                | 7.60       |  |
| % DPER < TPER                      | 0.43                   | DPER          | 76.13 | TPER          | 76.46          |            |  |
|                                    |                        |               |       |               |                |            |  |
| 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

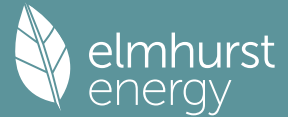
|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of 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 Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K  
List of Thermal Bridges

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

|                                                                  | Length  | Psi-value             | Total        |
|------------------------------------------------------------------|---------|-----------------------|--------------|
| K1 Element                                                       |         |                       |              |
| 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       |
| E4 Jamb                                                          | 30.3000 | 0.0170                | 0.5151       |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920                | 1.8575       |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920                | 1.8575       |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010                | 0.0279       |
| 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       |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600                | 0.5460       |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200                | 2.4032       |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560                | 0.4956       |
| E16 Corner (normal)                                              | 18.5000 | 0.0460                | 0.8510       |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380                | 0.5951       |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880               | -0.4998      |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690                | 0.6093       |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690                | 0.5513       |
| 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       |
| 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)       |         |                       | 24.8859 (36) |
| Point Thermal bridges                                            |         |                       | 0.0000       |
| Total fabric heat loss                                           |         | (33) + (36) + (36a) = | 82.2773 (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                                                 | 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) |
| Average = Sum(39)m / 12 =                                           | 134.7885 | 134.4964 | 134.2101 | 132.8654 | 132.6138 | 131.4425 | 131.4425 | 131.2256 | 131.8937 | 132.6138 | 133.1227 | 133.6549 | (39) |
|                                                                     |          |          |          |          |          |          |          |          |          |          |          | 132.8642 |      |
| HLP                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| HLP (average)                                                       | 1.2744   | 1.2716   | 1.2689   | 1.2562   | 1.2538   | 1.2427   | 1.2427   | 1.2407   | 1.2470   | 1.2538   | 1.2586   | 1.2636   | (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                               | 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      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov      | Dec      |              |
| Energy conte                                                    | 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 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                    |          |          |          |         |         |         |         |         |         |         |          |          |              |
| 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                                                      | 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)         |
| Total heat required for water heating calculated for each month |          |          |          |         |         |         |         |         |         |         |          |          |              |
| WWHRS                                                           | 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)         |
| 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                                                 | 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)                                     |          |          |          |         |         |         |         |         |         |         |          |          |              |
| 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)        |
| 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)         |
|                                                                 |          |          |          |         |         |         |         |         |         |         |          |          | 955 (64)     |

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

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| (66)m                                                                               | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 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) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), 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) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), 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) |
| Pumps, fans                                                                         | 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) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 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) |
| Water heating gains (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) |
|                                                                                     | 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) |

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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> | Specific data<br>or Table 6b | 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     |
| Total gains | 628.7088               | 744.7212                                   | 852.7428                     | 995.3936                     | 1083.9220                    | 1084.6798    |

## 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                                                                         | 62.7483                   | 62.8846 | 63.0188 | 63.6566 | 63.7773 | 64.3456 | 64.3456 | 64.4520 | 64.1255 | 63.7773 | 63.5335 | 63.2806      |
| alpha                                                                       | 5.1832                    | 5.1923  | 5.2013  | 5.2438  | 5.2518  | 5.2897  | 5.2897  | 5.2968  | 5.2750  | 5.2518  | 5.2356  | 5.2187       |
| util living area                                                            | 0.9990                    | 0.9974  | 0.9923  | 0.9675  | 0.8890  | 0.7187  | 0.5465  | 0.6136  | 0.8690  | 0.9848  | 0.9977  | 0.9993 (86)  |
| MIT                                                                         | 19.5603                   | 19.7374 | 20.0234 | 20.4265 | 20.7599 | 20.9450 | 20.9893 | 20.9811 | 20.8454 | 20.3955 | 19.9099 | 19.5357 (87) |
| Th 2                                                                        | 19.8610                   | 19.8632 | 19.8653 | 19.8753 | 19.8772 | 19.8860 | 19.8876 | 19.8876 | 19.8826 | 19.8772 | 19.8734 | 19.8694 (88) |
| util rest of house                                                          | 0.9986                    | 0.9964  | 0.9889  | 0.9528  | 0.8402  | 0.6173  | 0.4144  | 0.4769  | 0.7932  | 0.9755  | 0.9966  | 0.9990 (89)  |
| MIT 2                                                                       | 18.5572                   | 18.7355 | 19.0213 | 19.4217 | 19.7226 | 19.8635 | 19.8838 | 19.8831 | 19.8020 | 19.3994 | 18.9160 | 18.5393 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         | 0.1677 (91)  |
| MIT                                                                         | 18.7254                   | 18.9036 | 19.1894 | 19.5902 | 19.8966 | 20.0449 | 20.0692 | 20.0673 | 19.9770 | 19.5664 | 19.0827 | 18.7064 (92) |
| Temperature adjustment                                                      |                           |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.7254                   | 18.9036 | 19.1894 | 19.5902 | 19.8966 | 20.0449 | 20.0692 | 20.0673 | 19.9770 | 19.5664 | 19.0827 | 18.7064 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |           |           |                            |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|----------------------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec                        |
| Utilisation                                                                    | 0.9981    | 0.9951    | 0.9861    | 0.9480    | 0.8412    | 0.6330   | 0.4368   | 0.5001   | 0.8009   | 0.9719    | 0.9954    | 0.9985 (94)                |
| Useful gains                                                                   | 627.4850  | 741.0688  | 840.9216  | 943.6050  | 911.8267  | 686.5679 | 452.6613 | 474.6520 | 678.7771 | 690.8492  | 623.2776  | 597.2350 (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                                                               | 1944.3841 | 1883.4308 | 1703.0456 | 1420.3609 | 1086.9839 | 715.6907 | 456.0002 | 481.2402 | 775.1434 | 1189.0733 | 1595.1731 | 1938.8496 (97)             |
| Space heating kWh                                                              | 979.7729  | 767.6672  | 641.4203  | 343.2642  | 130.3170  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 370.6788  | 699.7648  | 998.1612 (98a)             |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |           |           | 4931.0463                  |
| 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                                                              | 979.7729  | 767.6672  | 641.4203  | 343.2642  | 130.3170  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 370.6788  | 699.7648  | 998.1612 (98c)             |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |           | 4931.0463                  |
| Space heating per m <sup>2</sup>                                               |           |           |           |           |           |          |          |          |          |           |           | (98c) / (4) = 46.6205 (99) |

## 8c. Space cooling requirement

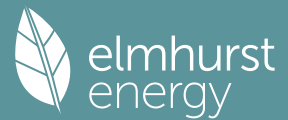
|                                                     |                          |        |        |        |         |           |           |           |         |         |        |                |
|-----------------------------------------------------|--------------------------|--------|--------|--------|---------|-----------|-----------|-----------|---------|---------|--------|----------------|
| 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  | 1235.5599 | 972.6748  | 997.3149  | 0.0000  | 0.0000  | 0.0000 | 0.0000 (100)   |
| Utilisation                                         | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.8301    | 0.9026    | 0.8628    | 0.0000  | 0.0000  | 0.0000 | 0.0000 (101)   |
| Useful loss                                         | 0.0000                   | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 1025.6863 | 877.9814  | 860.4519  | 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  | 128.7984  | 203.1701  | 142.5350  | 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  | 32.1996   | 50.7925   | 35.6338   | 0.0000  | 0.0000  | 0.0000 | 0.0000 (107)   |
| Space cooling requirement                           |                          |        |        |        |         |           |           |           |         |         |        | 118.6259 (107) |
| Energy for space heating                            |                          |        |        |        |         |           |           |           |         |         |        | 46.6205 (99)   |
| Energy for space cooling                            |                          |        |        |        |         |           |           |           |         |         |        | 1.1215 (108)   |
| Total                                               |                          |        |        |        |         |           |           |           |         |         |        | 47.7420 (109)  |
| Fabric Energy Efficiency (DFEE)                     |                          |        |        |        |         |           |           |           |         |         |        | 47.7 (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<br>(m <sup>2</sup> ) | Storey height<br>(m) | Volume<br>(m <sup>3</sup> ) |
|---------------------------|----------------------|-----------------------------|

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|                                                        |              |   |                                           |   |                      |
|--------------------------------------------------------|--------------|---|-------------------------------------------|---|----------------------|
| 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                                                                | 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) = | Air changes per hour        |              |
| Pressure test                                                                                      | 40.0000 / (5) =             | 0.1467 (8)   |
| Pressure Test Method                                                                               | Yes                         |              |
| Measured/design AP50                                                                               | Blower Door                 |              |
| Infiltration rate                                                                                  | 5.0000                      | (17)         |
| Number of sides sheltered                                                                          | 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)  |

|                                                                                                         |        |        |        |        |        |        |        |        |        |        |        |        |       |
|---------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 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) |
|                                                                                                         | 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

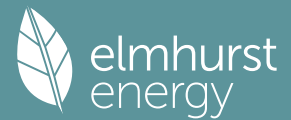
| Element                                                          | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K     | A x K<br>kJ/K |
|------------------------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|-----------------------|---------------|
| 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)                              |             |                |               | (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                |               |
| E4 Jamb                                                          |             |                |               | 30.3000              | 0.0500       | 1.5150                |               |
| E5 Ground floor (normal)                                         |             |                |               | 20.1900              | 0.1600       | 3.2304                |               |
| E5 Ground floor (normal)                                         |             |                |               | 20.1900              | 0.1600       | 3.2304                |               |
| E6 Intermediate floor within a dwelling                          |             |                |               | 27.8700              | 0.0000       | 0.0000                |               |
| 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                |               |
| E10 Eaves (insulation at ceiling level)                          |             |                |               | 9.1000               | 0.0600       | 0.5460                |               |
| E21 Exposed floor (inverted)                                     |             |                |               | 7.5100               | 0.3200       | 2.4032                |               |
| E12 Gable (insulation at ceiling level)                          |             |                |               | 8.8500               | 0.0600       | 0.5310                |               |
| E16 Corner (normal)                                              |             |                |               | 18.5000              | 0.0900       | 1.6650                |               |
| E18 Party wall between dwellings                                 |             |                |               | 15.6600              | 0.0600       | 0.9396                |               |
| E17 Corner (inverted - internal area greater than external area) |             |                |               | 5.6800               | -0.0900      | -0.5112               |               |
| P1 Party wall - Ground floor                                     |             |                |               | 8.8300               | 0.0800       | 0.7064                |               |
| E20 Exposed floor (normal)                                       |             |                |               | 7.9900               | 0.3200       | 2.5568                |               |
| 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                |               |
| 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)       |             |                |               |                      |              |                       | 30.3751 (36)  |
| Point Thermal bridges                                            |             |                |               |                      |              | (36a) =               | 0.0000        |
| Total fabric heat loss                                           |             |                |               |                      |              | (33) + (36) + (36a) = | 85.6769 (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                                                 | 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) |
| Average = Sum(39)m / 12 =                                           | 140.5141 | 140.1317 | 139.7569 | 137.9963 | 137.6669 | 136.1335 | 136.1335 | 135.8495 | 136.7242 | 137.6669 | 138.3333 | 139.0299 | (39) |
|                                                                     |          |          |          |          |          |          |          |          |          |          |          | 137.9947 |      |
| HLP                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| HLP (average)                                                       | 1.3285   | 1.3249   | 1.3213   | 1.3047   | 1.3016   | 1.2871   | 1.2871   | 1.2844   | 1.2927   | 1.3016   | 1.3079   | 1.3145   | (40) |
| Days in mont                                                        | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |



8. Space heating requirement

# Full SAP Calculation Printout



|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov           | Dec       |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|---------------|-----------|-------|
| Utilisation                                                                    | 0.9982    | 0.9958    | 0.9891    | 0.9610    | 0.8778    | 0.6882   | 0.4834   | 0.5481   | 0.8372   | 0.9773    | 0.9959        | 0.9986    | (94)  |
| Useful gains                                                                   | 613.3186  | 713.8274  | 797.9706  | 891.7978  | 878.5188  | 687.7447 | 461.7476 | 482.2730 | 664.7264 | 662.3267  | 605.8759      | 585.5505  | (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                                                               | 2011.3284 | 1945.5251 | 1755.6347 | 1458.4394 | 1115.6711 | 734.9316 | 467.9074 | 493.6402 | 794.9299 | 1221.7714 | 1644.3743     | 2002.4045 | (97)  |
| Space heating kWh                                                              | 1040.1193 | 827.7008  | 712.5021  | 407.9819  | 176.4413  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 416.2269  | 747.7189      | 1054.1393 | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |           |               | 5382.8305 |       |
| 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                                                              | 1040.1193 | 827.7008  | 712.5021  | 407.9819  | 176.4413  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 416.2269  | 747.7189      | 1054.1393 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |               | 5382.8305 |       |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          |           | (98c) / (4) = | 50.8918   | (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  | 1279.6550 | 1007.3880 | 1032.4566 | 0.0000                   | 0.0000  | 0.0000 | 0.0000  | (100) |
| Utilisation                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 0.7701    | 0.8563    | 0.8107    | 0.0000                   | 0.0000  | 0.0000 | 0.0000  | (101) |
| Useful loss                      | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 985.5195  | 862.6681  | 836.9731  | 0.0000                   | 0.0000  | 0.0000 | 0.0000  | (102) |
| Total gains                      | 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) |
| Space cooling kWh                | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000  | 85.9223   | 144.0200  | 99.7011   | 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  | 21.4806   | 36.0050   | 24.9253   | 0.0000                   | 0.0000  | 0.0000 | 0.0000  | (107) |
| Space cooling requirement        |        |        |        |        |         |           |           |           |                          |         |        | 82.4108 | (107) |
| Energy for space heating         |        |        |        |        |         |           |           |           |                          |         |        | 50.8918 | (99)  |
| Energy for space cooling         |        |        |        |        |         |           |           |           |                          |         |        | 0.7792  | (108) |
| Total                            |        |        |        |        |         |           |           |           |                          |         |        | 51.6710 | (109) |
| Fabric Energy Efficiency (TFEE)  |        |        |        |        |         |           |           |           |                          |         |        | 51.7    | (109) |

# Full SAP Calculation Printout



|                                    |                        |               |               |                |                |            |
|------------------------------------|------------------------|---------------|---------------|----------------|----------------|------------|
| Property Reference                 | SAP VG 21-0282         |               |               |                | Issued on Date | 15/11/2024 |
| Assessment Reference               | Plot 46                |               | Prop Type Ref | SAP VG 21-0282 |                |            |
| Property                           |                        |               |               |                |                |            |
|                                    |                        |               |               |                |                |            |
| SAP Rating                         | 91 B                   | DER           | 14.43         | TER            | 14.52          |            |
| Environmental                      | 87 B                   | % DER < TER   |               |                |                | 0.62       |
| CO <sub>2</sub> Emissions (t/year) | 1.47                   | DFEE          | 47.74         | TFEE           | 51.67          |            |
| Compliance Check                   | See BREL               | % DFEE < TFEE |               |                |                | 7.60       |
| % DPER < TPER                      | 0.43                   | DPER          | 76.13         | TPER           | 76.46          |            |
|                                    |                        |               |               |                |                |            |
| 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

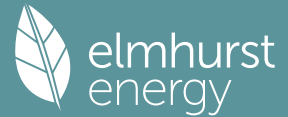
|                                                                                                  | m <sup>3</sup> per hour                 |
|--------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of open 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                                                       |         |           |                                    |
| 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                             |
| E4 Jamb                                                          | 30.3000 | 0.0170    | 0.5151                             |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                             |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                             |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010    | 0.0279                             |
| 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                             |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460                             |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032                             |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560    | 0.4956                             |
| E16 Corner (normal)                                              | 18.5000 | 0.0460    | 0.8510                             |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380    | 0.5951                             |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880   | -0.4998                            |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690    | 0.6093                             |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690    | 0.5513                             |
| 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                             |
| 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)       |         |           | 24.8859 (36)                       |
| Point Thermal bridges                                            |         |           | (36a) = 0.0000                     |
| Total fabric heat loss                                           |         |           | (33) + (36) + (36a) = 82.2773 (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       | 138.3079 | 137.8792 | 137.4589 | 135.4850 | 135.1157 | 133.3964 | 133.3964 | 133.0781 | 134.0587 | 135.1157 | 135.8628 | 136.6439 | (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 135.4832 |      |
| HLP                       | 1.3076   | 1.3036   | 1.2996   | 1.2809   | 1.2774   | 1.2612   | 1.2612   | 1.2582   | 1.2675   | 1.2774   | 1.2845   | 1.2919   | (40) |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.2809   |      |
| Days in mont              | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

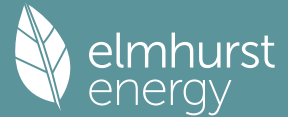
## 4. Water heating energy requirements (kWh/year)

|                                                                 |          |          |          |          |          |          |          |          |          |                                        |          |           |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------|----------|-----------|-------------|
| 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)       |
|                                                                 |          |          |          |          |          |          |          |          |          |                                        |          | 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                                                                               | 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) |

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## 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 | 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                                                                         | 61.1516 | 61.3418 | 61.5293 | 62.4258 | 62.5964 | 63.4031 | 63.4031 | 63.5548 | 63.0899 | 62.5964 | 62.2522 | 61.8963 |      |
| alpha                                                                       | 5.0768  | 5.0895  | 5.1020  | 5.1617  | 5.1731  | 5.2269  | 5.2269  | 5.2370  | 5.2060  | 5.1731  | 5.1501  | 5.1264  |      |
| util living area                                                            | 0.9986  | 0.9965  | 0.9903  | 0.9632  | 0.8816  | 0.7109  | 0.5406  | 0.6045  | 0.8594  | 0.9814  | 0.9968  | 0.9989  | (86) |
| MIT                                                                         | 20.4577 | 20.5027 | 20.5749 | 20.6781 | 20.7609 | 20.8085 | 20.8194 | 20.8178 | 20.7838 | 20.6721 | 20.5499 | 20.4548 | (87) |
| Th 2                                                                        | 19.8349 | 19.8380 | 19.8411 | 19.8558 | 19.8585 | 19.8714 | 19.8714 | 19.8737 | 19.8664 | 19.8585 | 19.8530 | 19.8472 | (88) |
| util rest of house                                                          | 0.9980  | 0.9951  | 0.9862  | 0.9467  | 0.8306  | 0.6085  | 0.4081  | 0.4676  | 0.7805  | 0.9703  | 0.9953  | 0.9984  | (89) |
| MIT 2                                                                       | 19.1845 | 19.2450 | 19.3398 | 19.4819 | 19.5794 | 19.6360 | 19.6424 | 19.6445 | 19.6125 | 19.4792 | 19.3193 | 19.1922 | (90) |
| Living area fraction                                                        | 19.3981 | 19.4559 | 19.5469 | 19.6826 | 19.7776 | 19.8327 | 19.8398 | 19.8413 | 19.8090 | 19.6793 | 19.5257 | 19.4039 | (91) |
| MIT                                                                         | 19.3981 | 19.4559 | 19.5469 | 19.6826 | 19.7776 | 19.8327 | 19.8398 | 19.8413 | 19.8090 | 19.6793 | 19.5257 | 19.4039 | (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | -0.1500 |      |
| adjusted MIT                                                                | 19.2481 | 19.3059 | 19.3969 | 19.5326 | 19.6276 | 19.6827 | 19.6898 | 19.6913 | 19.6590 | 19.5293 | 19.3757 | 19.2539 | (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |               |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|-----------|-----------|-------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec       |       |
| Utilisation                                                                    | 0.9976    | 0.9942    | 0.9841    | 0.9407    | 0.8181    | 0.5896   | 0.3859   | 0.4440   | 0.7625   | 0.9657        | 0.9944    | 0.9981    | (94)  |
| Useful gains                                                                   | 680.8947  | 792.6561  | 887.8786  | 976.0133  | 917.6281  | 657.3310 | 410.3831 | 434.3794 | 670.3675 | 724.8350      | 669.1514  | 649.7341  | (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                                                               | 2067.4342 | 1986.2760 | 1772.7961 | 1440.5516 | 1071.1381 | 678.0118 | 412.1692 | 438.0011 | 745.2255 | 1206.4883     | 1667.8152 | 2057.0267 | (97)  |
| Space heating kWh                                                              | 1031.5854 | 802.1125  | 658.3786  | 334.4676  | 114.2114  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 358.3501      | 719.0380  | 1047.0256 | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |               |           | 5065.1692 |       |
| 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                                                              | 1031.5854 | 802.1125  | 658.3786  | 334.4676  | 114.2114  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 358.3501      | 719.0380  | 1047.0256 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |               |           | 5065.1692 |       |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          | (98c) / (4) = |           | 47.8885   | (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                                                                            | 1031.5854 | 802.1125 | 658.3786 | 334.4676  | 114.2114  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 358.3501 | 719.0380 | 1047.0256 | (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)                                                             | 1164.3176 | 905.3189 | 743.0910 | 377.5029  | 128.9068  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 404.4584 | 811.5553 | 1181.7445 | (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 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                                                                    | 86.7994   | 86.6137  | 86.2042  | 85.1891   | 82.9368   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 85.3311  | 86.4645  | 79.6000   | (216)  |
| Fuel for water heating, kWh/month                                                                    | 267.0553  | 235.6279 | 248.9161 | 215.2666  | 209.9728  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 215.2014 | 232.4247 | 263.2297  | (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)                                        | -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)                              |           |          |          |           |           |           |           |           |           |          |          |           |        |

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|                                                                                                      |        |        |        |        |        |        |        |        |        |        |        |            |        |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------------|--------|
| (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                                                                   |        |        |        |        |        |        |        |        |        |        |        | 5716.8953  | (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                                                                              |        |        |        |        |        |        |        |        |        |        |        | 2663.9377  | (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                                                                  |        |        |        |        |        |        |        |        |        |        |        | 6499.3122  | (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                   | 5716.8953          | 0.2100                        | 1200.5480 (261)          |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                      | 2663.9377          | 0.2100                        | 559.4269 (264)           |
| Space and water heating                         |                    |                               | 1759.9749 (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                              |                    |                               | 1526.7772 (272)          |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 14.4300 (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               | 5716.8953          | 1.1300                              | 6460.0917 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2663.9377          | 1.1300                              | 3010.2496 (278)            |
| Space and water heating                     |                    |                                     | 9470.3413 (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               |                    |                                     | 8052.6835 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 76.1300 (287)              |

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

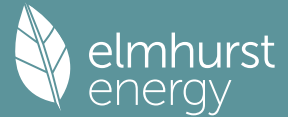
### 1. Overall dwelling characteristics

|                                                        | 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                | 4 * 10 = 40.0000 (7a) |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b)  |

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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) =  
Pressure test  
Pressure Test Method  
Measured/design AP50  
Infiltration rate  
Number of sides sheltered

Air changes per hour  
40.0000 / (5) = 0.1467 (8)  
Yes  
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 |        |        |        |        |        |        |        |        |        |        |        |              |
| 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)            |             |                |               |                  | 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  |
| E4 Jamb                                                          | 30.3000 | 0.0500    | 1.5150  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.1600    | 3.2304  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.1600    | 3.2304  |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0000    | 0.0000  |
| 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  |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460  |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032  |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0600    | 0.5310  |
| E16 Corner (normal)                                              | 18.5000 | 0.0900    | 1.6650  |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0600    | 0.9396  |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0900   | -0.5112 |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0800    | 0.7064  |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.3200    | 2.5568  |
| 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  |
| 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)

30.3751 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 85.6769 (37)

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

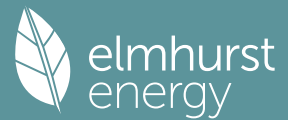
|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (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       | 140.5141 | 140.1317 | 139.7569 | 137.9963 | 137.6669 | 136.1335 | 136.1335 | 135.8495 | 136.7242 | 137.6669 | 138.3333 | 139.0299 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 137.9947      |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.3285 | 1.3249 | 1.3213 | 1.3047 | 1.3016 | 1.2871 | 1.2871 | 1.2844 | 1.2927 | 1.3016 | 1.3079 | 1.3145 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.3047      |
| 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) |           |
|                                          |          |          |          |          |          |          |          |          |          | 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                       |          |          |          |          |          |          |          |          |          |                    |               |               |           |

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|                                                                 |                                        |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| If cylinder contains dedicated solar storage                    | 0.0000                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (56)    |
| 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                                                      | 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)   |
| 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)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| 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)                                                       | 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)

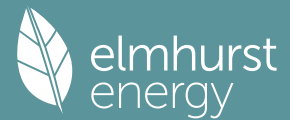
|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| 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                                                                         | 60.1915 | 60.3557 | 60.5176 | 61.2897 | 61.4364 | 62.1284 | 62.1284 | 62.2582 | 61.8600 | 61.4364 | 61.1404 | 60.8340 |              |
| alpha                                                                       | 5.0128  | 5.0237  | 5.0345  | 5.0860  | 5.0958  | 5.1419  | 5.1419  | 5.1505  | 5.1240  | 5.0958  | 5.0760  | 5.0556  |              |
| util living area                                                            | 0.9985  | 0.9967  | 0.9918  | 0.9707  | 0.9053  | 0.7524  | 0.5817  | 0.6435  | 0.8804  | 0.9836  | 0.9969  | 0.9988  | (86)         |
| MIT                                                                         | 19.5372 | 19.7036 | 19.9775 | 20.3711 | 20.7126 | 20.9253 | 20.9840 | 20.9739 | 20.8211 | 20.3728 | 19.8938 | 19.5182 | (87)         |
| Th 2                                                                        | 19.8186 | 19.8214 | 19.8242 | 19.8372 | 19.8396 | 19.8510 | 19.8510 | 19.8531 | 19.8466 | 19.8396 | 19.8347 | 19.8295 | (88)         |
| util rest of house                                                          | 0.9979  | 0.9954  | 0.9882  | 0.9570  | 0.8601  | 0.6497  | 0.4394  | 0.4993  | 0.8065  | 0.9734  | 0.9954  | 0.9984  | (89)         |
| MIT 2                                                                       | 18.1285 | 18.3432 | 18.6943 | 19.1966 | 19.5979 | 19.8108 | 19.8467 | 19.8450 | 19.7255 | 19.2075 | 18.5966 | 18.1118 | (90)         |
| Living area fraction                                                        | 18.3648 | 18.5714 | 18.9095 | 19.3936 | 19.7849 | 19.9977 | 20.0374 | 20.0343 | 19.9092 | 19.4029 | 18.8142 | 18.3477 | (91)         |
| MIT                                                                         | 18.3648 | 18.5714 | 18.9095 | 19.3936 | 19.7849 | 19.9977 | 20.0374 | 20.0343 | 19.9092 | 19.4029 | 18.8142 | 18.3477 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 18.3648 | 18.5714 | 18.9095 | 19.3936 | 19.7849 | 19.9977 | 20.0374 | 20.0343 | 19.9092 | 19.4029 | 18.8142 | 18.3477 | (93)         |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |           |           |           |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------|-------|
| Utilisation                                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec       |       |
| Useful gains                                                                   | 0.9968    | 0.9933    | 0.9841    | 0.9499    | 0.8575    | 0.6642   | 0.4635   | 0.5236   | 0.8114   | 0.9679    | 0.9933    | 0.9974    | (94)  |
| Ext temp.                                                                      | 682.3335  | 780.3291  | 858.6134  | 936.9466  | 904.5785  | 694.6207 | 462.8550 | 484.4671 | 683.1286 | 710.2136  | 666.8992  | 653.7921  | (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                                                              | 1976.2970 | 1915.7939 | 1734.3116 | 1448.0753 | 1113.0178 | 734.8079 | 467.9496 | 493.7242 | 794.2641 | 1211.8691 | 1620.4657 | 1966.9500 | (97)  |
| Space heating requirement - total per year (kWh/year)                          | 962.7088  | 763.0323  | 651.5194  | 368.0127  | 155.0789  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 373.2317  | 686.5679  | 976.9895  | (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)                         | 962.7088  | 763.0323  | 651.5194  | 368.0127  | 155.0789  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 373.2317  | 686.5679  | 976.9895  | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |           | 4937.1412 |       |
| Space heating per m <sup>2</sup>                                               |           |           |           |           |           |          |          |          |          |           |           | 46.6781   | (99)  |

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

# Full SAP Calculation Printout



|                                                                                                      |           |          |          |           |           |           |           |           |           |          |          |            |        |
|------------------------------------------------------------------------------------------------------|-----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------|--------|
| 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                                                                            | 962.7088  | 763.0323 | 651.5194 | 368.0127  | 155.0789  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 373.2317 | 686.5679 | 976.9895   | (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)                                                             | 1041.8927 | 825.7925 | 705.1076 | 398.2822  | 167.8343  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 403.9304 | 743.0388 | 1057.3479  | (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                                                                           | 86.9929   | 86.8258  | 86.4618  | 85.6157   | 83.8481   | 80.3000   | 80.3000   | 80.3000   | 80.3000   | 85.6186  | 86.6446  | 80.3000    | (216)  |
| Fuel for water heating, kWh/month                                                                    | 284.8212  | 252.3026 | 269.3233 | 239.8853  | 237.8712  | 224.3345  | 221.9545  | 230.5907  | 232.8868  | 242.9327 | 254.4391 | 281.7209   | (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    | 7.0685    | 7.3041    | 7.0685   | 7.3041   | 7.0685     | (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                                                                   |           |          |          |           |           |           |           |           |           |          |          | 5343.2265  | (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                                                                              |           |          |          |           |           |           |           |           |           |          |          | 2973.0627  | (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                                                                  |           |          |          |           |           |           |           |           |           |          |          | 6654.7684  | (238)  |

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

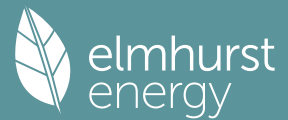
|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |       |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|-------|
| Space heating - main system 1                 | 5343.2265          | 0.2100                        | 1122.0776                | (261) |
| Total CO2 associated with community systems   |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                    | 2973.0627          | 0.2100                        | 624.3432                 | (264) |
| Space and water heating                       |                    |                               | 1746.4207                | (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                            |                    |                               | 1535.6629                | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 14.5200                  | (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               | 5343.2265          | 1.1300                              | 6037.8459                  | (275) |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473) |
| Water heating (other fuel)                  | 2973.0627          | 1.1300                              | 3359.5609                  | (278) |
| Space and water heating                     |                    |                                     | 9397.4068                  | (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               |                    |                                     | 8087.6323                  | (286) |
| Target Primary Energy Rate (TPER)           |                    |                                     | 76.4600                    | (287) |



# Full SAP Calculation Printout



|                                    |                        |               |       |               |                |            |  |
|------------------------------------|------------------------|---------------|-------|---------------|----------------|------------|--|
| Property Reference                 | SAP VG 21-0282         |               |       |               | Issued on Date | 15/11/2024 |  |
| Assessment Reference               | Plot 46                |               |       | Prop Type Ref | SAP VG 21-0282 |            |  |
| Property                           |                        |               |       |               |                |            |  |
|                                    |                        |               |       |               |                |            |  |
| SAP Rating                         | 91 B                   | DER           | 14.43 | TER           | 14.52          |            |  |
| Environmental                      | 87 B                   | % DER < TER   |       |               |                | 0.62       |  |
| CO <sub>2</sub> Emissions (t/year) | 1.47                   | DFEE          | 47.74 | TFEE          | 51.67          |            |  |
| Compliance Check                   | See BREL               | % DFEE < TFEE |       |               |                | 7.60       |  |
| % DPER < TPER                      | 0.43                   | DPER          | 76.13 | TPER          | 76.46          |            |  |
|                                    |                        |               |       |               |                |            |  |
| 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

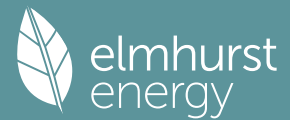
|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of 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                                                       |         |           |                                    |
| 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                             |
| E4 Jamb                                                          | 30.3000 | 0.0170    | 0.5151                             |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                             |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                             |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010    | 0.0279                             |
| 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                             |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460                             |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032                             |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560    | 0.4956                             |
| E16 Corner (normal)                                              | 18.5000 | 0.0460    | 0.8510                             |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380    | 0.5951                             |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880   | -0.4998                            |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690    | 0.6093                             |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690    | 0.5513                             |
| 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                             |
| 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)       |         |           | 24.8859 (36)                       |
| Point Thermal bridges                                            |         |           | (36a) = 0.0000                     |
| Total fabric heat loss                                           |         |           | (33) + (36) + (36a) = 82.2773 (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       | 138.3079 | 137.8792 | 137.4589 | 135.4850 | 135.1157 | 133.3964 | 133.3964 | 133.0781 | 134.0587 | 135.1157 | 135.8628 | 136.6439 | (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 135.4832 |      |
| HLP                       | 1.3076   | 1.3036   | 1.2996   | 1.2809   | 1.2774   | 1.2612   | 1.2612   | 1.2582   | 1.2675   | 1.2774   | 1.2845   | 1.2919   | (40) |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.2809   |      |
| Days in mont              | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31       |      |

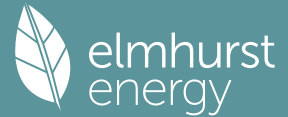
## 4. Water heating energy requirements (kWh/year)

|                                                                                |          |          |          |          |          |          |          |          |          |                    |          |           |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|----------|-----------|-------------|
| 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    | (64a)       |
| 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                                                    |           |           |           |           |           |           |           |           |           |           |           |           |      |
| (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   |           | 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) |

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## 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      |
| Total gains | 749.7555 | 846.9290 | 958.2193   | 1075.6785                      | 1150.8499                         | 1128.5450                          | 1076.9584                    | 994.2008   | 899.2630      |
|             |          |          |            |                                |                                   |                                    |                              | 241.5726   | 129.8276      |
|             |          |          |            |                                |                                   |                                    |                              | 788.4409   | 719.8105      |
|             |          |          |            |                                |                                   |                                    |                              |            | 85.7318 (83)  |
|             |          |          |            |                                |                                   |                                    |                              |            | 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                                                                         | 61.1516 | 61.3418 | 61.5293 | 62.4258 | 62.5964 | 63.4031 | 63.4031 | 63.5548 | 63.0899             | 62.5964 | 62.2522 | 61.8963      |
| alpha                                                                       | 5.0768  | 5.0895  | 5.1020  | 5.1617  | 5.1731  | 5.2269  | 5.2269  | 5.2370  | 5.2060              | 5.1731  | 5.1501  | 5.1264       |
| util living area                                                            | 0.9978  | 0.9954  | 0.9875  | 0.9578  | 0.8725  | 0.7045  | 0.5344  | 0.5961  | 0.8505              | 0.9773  | 0.9957  | 0.9983 (86)  |
| MIT                                                                         | 20.4724 | 20.5134 | 20.5865 | 20.6849 | 20.7643 | 20.8091 | 20.8196 | 20.8181 | 20.7858             | 20.6796 | 20.5600 | 20.4684 (87) |
| Th 2                                                                        | 19.8349 | 19.8380 | 19.8411 | 19.8558 | 19.8585 | 19.8714 | 19.8714 | 19.8737 | 19.8664             | 19.8585 | 19.8530 | 19.8472 (88) |
| util rest of house                                                          | 0.9969  | 0.9936  | 0.9823  | 0.9394  | 0.8194  | 0.6022  | 0.4031  | 0.4604  | 0.7695              | 0.9640  | 0.9936  | 0.9976 (89)  |
| MIT 2                                                                       | 19.2033 | 19.2586 | 19.3543 | 19.4900 | 19.5826 | 19.6364 | 19.6424 | 19.6446 | 19.6141             | 19.4883 | 19.3323 | 19.2097 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / | (4) =   |         | 0.1677 (91)  |
| MIT                                                                         | 19.4161 | 19.4691 | 19.5610 | 19.6904 | 19.7808 | 19.8331 | 19.8399 | 19.8414 | 19.8107             | 19.6881 | 19.5382 | 19.4208 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                     |         |         | -0.1500      |
| adjusted MIT                                                                | 19.2661 | 19.3191 | 19.4110 | 19.5404 | 19.6308 | 19.6831 | 19.6899 | 19.6914 | 19.6607             | 19.5381 | 19.3882 | 19.2708 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |           |          |          |          |          |               |           |                 |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|---------------|-----------|-----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec             |
| Utilisation                                                                    | 0.9963    | 0.9925    | 0.9797    | 0.9330    | 0.8067    | 0.5834   | 0.3812   | 0.4372   | 0.7513   | 0.9588        | 0.9925    | 0.9971 (94)     |
| Useful gains                                                                   | 746.9920  | 840.5745  | 938.7707  | 1003.5766 | 928.3798  | 658.3560 | 410.4922 | 434.6484 | 675.6411 | 755.9522      | 714.4033  | 711.2827 (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                                                               | 2069.9339 | 1988.0891 | 1774.7327 | 1441.6146 | 1071.5776 | 678.0609 | 412.1766 | 438.0180 | 745.4546 | 1207.6759     | 1669.5082 | 2059.3307 (97)  |
| Space heating kWh                                                              | 984.2688  | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824      | 687.6755  | 1002.9477 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |               |           | 4825.9864       |
| 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                                                              | 984.2688  | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824      | 687.6755  | 1002.9477 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |               |           | 4825.9864       |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          | (98c) / (4) = |           | 45.6272 (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                                                                            | 984.2688  | 771.1297 | 621.9557 | 315.3874  | 106.5391  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 336.0824 | 687.6755 | 1002.9477 (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)                                                             | 1110.9129 | 870.3496 | 701.9816 | 355.9677  | 120.2473  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 379.3255 | 776.1575 | 1131.9951 (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                                                                           |           |          |          |           |           |           |           |           |           |          |          | 79.6000 (216)   |
| (217)m                                                                                               | 86.7308   | 86.5520  | 86.1028  | 85.0638   | 82.7922   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 85.1964  | 86.3910  | 86.7788 (217)   |
| Fuel for water heating, kWh/month                                                                    | 267.2664  | 235.7957 | 249.2092 | 215.5836  | 210.3396  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 215.5415 | 232.6224 | 263.4168 (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)   |

# Full SAP Calculation Printout



|                                                                                                      |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| 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 | 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 | 0.0000    | (235d) |
| Annual totals kWh/year                                                                               |        |        |        |        |        |        |        |        |        |        |        |        |           |        |
| Space heating fuel - main system 1                                                                   |        |        |        |        |        |        |        |        |        |        |        |        | 5446.9373 | (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                                                                              |        |        |        |        |        |        |        |        |        |        |        |        | 2666.0186 | (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                           |  |  |  |  |  |  |  |  |  |  |  |  | 6231.4351  | (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               | 5446.9373        | 3.6400              | 198.2685            | (240)  |
| Total CO2 associated with community systems |                  |                     | 0.0000              | (473)  |
| Water heating (other fuel)                  | 2666.0186        | 3.6400              | 97.0431             | (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                           |                  |                     | 221.0664            | (255)  |

## 11a. SAP rating - Individual heating systems

|                                  |  |         |       |
|----------------------------------|--|---------|-------|
| Energy cost deflator (Table 12): |  | 0.3600  | (256) |
| Energy cost factor (ECF)         |  | 0.5278  | (257) |
| SAP value                        |  | 91.4436 |       |
| SAP rating (Section 12)          |  | 91      | (258) |
| SAP band                         |  | B       |       |

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

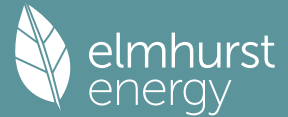
|                                             | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |       |
|---------------------------------------------|--------------------|-------------------------------|--------------------------|-------|
| Space heating - main system 1               | 5446.9373          | 0.2100                        | 1143.8568                | (261) |
| Total CO2 associated with community systems |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                  | 2666.0186          | 0.2100                        | 559.8639                 | (264) |
| Space and water heating                     |                    |                               | 1703.7207                | (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                          |                    |                               | 1470.5230                | (272) |
| CO2 emissions per m2                        |                    |                               | 13.9000                  | (273) |
| EI value                                    |                    |                               | 86.9304                  |       |
| EI rating                                   |                    |                               | 87                       | (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)    |

# Full SAP Calculation Printout



## 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 |      |
| 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          |
| 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>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            | (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  
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                                                          | 30.3000 | 0.0170    | 0.5151                             |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                             |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575                             |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010    | 0.0279                             |
| 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                             |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460                             |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032                             |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560    | 0.4956                             |
| E16 Corner (normal)                                              | 18.5000 | 0.0460    | 0.8510                             |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380    | 0.5951                             |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880   | -0.4998                            |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690    | 0.6093                             |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690    | 0.5513                             |
| 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                             |
| 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)       |         |           | 24.8859 (36)                       |
| Point Thermal bridges                                            |         |           | (36a) = 0.0000                     |
| Total fabric heat loss                                           |         |           | (33) + (36) + (36a) = 82.2773 (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                                                 | 138.3079 | 137.8792 | 137.4589 | 135.4850 | 135.1157 | 133.3964 | 133.3964 | 133.0781 | 134.0587 | 135.1157 | 135.8628 | 136.6439 (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 135.4832      |

|               |        |        |        |        |        |        |        |        |        |        |        |             |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
| HLP (average) | 1.3076 | 1.3036 | 1.2996 | 1.2809 | 1.2774 | 1.2612 | 1.2612 | 1.2582 | 1.2675 | 1.2774 | 1.2845 | 1.2919 (40) |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31          |

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

# Full SAP Calculation Printout



|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                              |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------|
| 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                          |          |          |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = 2210.0711 |
| Water storage loss:                                             | 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)                 |
| 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)                 |
| 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     |           | Solar flux |           | g             |          | FF            |          | Access   |          | Gains        |
|             |          |          | m2       |           | Table 6a   |           | Specific data |          | Specific data |          | factor   |          | W            |
|             |          |          |          |           | W/m2       |           | or Table 6b   |          | or Table 6c   |          | Table 6d |          |              |
| 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)         |

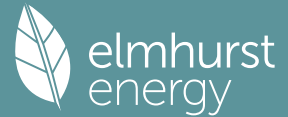
## 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| 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                                                                         | 61.1516 | 61.3418 | 61.5293 | 62.4258 | 62.5964 | 63.4031 | 63.4031 | 63.5548 | 63.0899 | 62.5964 | 62.2522 | 61.8963      |
| alpha                                                                       | 5.0768  | 5.0895  | 5.1020  | 5.1617  | 5.1731  | 5.2269  | 5.2269  | 5.2370  | 5.2060  | 5.1731  | 5.1501  | 5.1264       |
| util living area                                                            | 0.9978  | 0.9954  | 0.9875  | 0.9578  | 0.8725  | 0.7045  | 0.5344  | 0.5961  | 0.8505  | 0.9773  | 0.9957  | 0.9983 (86)  |
| MIT                                                                         | 20.4724 | 20.5134 | 20.5865 | 20.6849 | 20.7643 | 20.8091 | 20.8196 | 20.8181 | 20.7858 | 20.6796 | 20.5600 | 20.4684 (87) |
| Th 2                                                                        | 19.8349 | 19.8380 | 19.8411 | 19.8558 | 19.8585 | 19.8714 | 19.8714 | 19.8737 | 19.8664 | 19.8585 | 19.8530 | 19.8472 (88) |
| util rest of house                                                          | 0.9969  | 0.9936  | 0.9823  | 0.9394  | 0.8194  | 0.6022  | 0.4031  | 0.4604  | 0.7695  | 0.9640  | 0.9936  | 0.9976 (89)  |
| MIT 2                                                                       | 19.2033 | 19.2586 | 19.3543 | 19.4900 | 19.5826 | 19.6364 | 19.6424 | 19.6446 | 19.6141 | 19.4883 | 19.3323 | 19.2097 (90) |
| Living area fraction                                                        | 19.4161 | 19.4691 | 19.5610 | 19.6904 | 19.7808 | 19.8331 | 19.8399 | 19.8414 | 19.8107 | 19.6881 | 19.5382 | 19.4208 (92) |
| Temperature adjustment                                                      | 19.2661 | 19.3191 | 19.4110 | 19.5404 | 19.6308 | 19.6831 | 19.6899 | 19.6914 | 19.6607 | 19.5381 | 19.3882 | -0.1500      |
| adjusted MIT                                                                | 19.2661 | 19.3191 | 19.4110 | 19.5404 | 19.6308 | 19.6831 | 19.6899 | 19.6914 | 19.6607 | 19.5381 | 19.3882 | 19.2708 (93) |

## 8. Space heating requirement

|              |          |          |          |           |          |          |          |          |          |          |          |               |
|--------------|----------|----------|----------|-----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation  | Jan      | Feb      | Mar      | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Useful gains | 0.9963   | 0.9925   | 0.9797   | 0.9330    | 0.8067   | 0.5834   | 0.3812   | 0.4372   | 0.7513   | 0.9588   | 0.9925   | 0.9971 (94)   |
| Ext temp.    | 746.9920 | 840.5745 | 938.7707 | 1003.5766 | 928.3798 | 658.3560 | 410.4922 | 434.6484 | 675.6411 | 755.9522 | 714.4033 | 711.2827 (95) |
|              | 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)   |

# Full SAP Calculation Printout



|                                                                                |           |           |           |           |           |          |          |          |          |           |           |                            |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|----------------------------|
| Heat loss rate W                                                               | 2069.9339 | 1988.0891 | 1774.7327 | 1441.6146 | 1071.5776 | 678.0609 | 412.1766 | 438.0180 | 745.4546 | 1207.6759 | 1669.5082 | 2059.3307 (97)             |
| Space heating kWh                                                              | 984.2688  | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824  | 687.6755  | 1002.9477 (98a)            |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |           |           | 4825.9864                  |
| 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                                                              | 984.2688  | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824  | 687.6755  | 1002.9477 (98c)            |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |           | 4825.9864                  |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          |           |           | (98c) / (4) = 45.6272 (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)    |
| Space heating requirement                                                                            | Jan       | Feb      | Mar      | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct      | Nov      | Dec             |
| 984.2688                                                                                             | 771.1297  | 621.9557 | 315.3874 | 106.5391  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 336.0824 | 687.6755 | 1002.9477 (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)                                                             | 1110.9129 | 870.3496 | 701.9816 | 355.9677  | 120.2473  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 379.3255 | 776.1575 | 1131.9951 (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                                                                           | 86.7308   | 86.5520  | 86.1028  | 85.0638   | 82.7922   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 85.1964  | 86.3910  | 86.7788 (216)   |
| Fuel for water heating, kWh/month                                                                    | 267.2664  | 235.7957 | 249.2092 | 215.5836  | 210.3396  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 215.5415 | 232.6224 | 263.4168 (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    | 10.1711   | 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                                                                   |           |          |          |           |           |           |           |           |           |          |          | 5446.9373 (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                                                                              |           |          |          |           |           |           |           |           |           |          |          | 2666.0186 (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            |  |  | 6231.4351 (238)  |

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

|                                             | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |
|---------------------------------------------|---------------|------------------|------------------|
| Space heating - main system 1               | 5446.9373     | 5.6000           | 305.0285 (240)   |
| Total CO2 associated with community systems |               |                  | 0.0000 (473)     |
| Water heating (other fuel)                  | 2666.0186     | 5.6000           | 149.2970 (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                           |               |                  | 330.5567 (255)   |

# Full SAP Calculation Printout



## 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               | 5446.9373          | 0.2100                        | 1143.8568 (261)          |
| Total CO2 associated with community systems |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                  | 2666.0186          | 0.2100                        | 559.8639 (264)           |
| Space and water heating                     |                    |                               | 1703.7207 (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                          |                    |                               | 1470.5230 (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               | 5446.9373          | 1.1300                              | 6155.0391 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2666.0186          | 1.1300                              | 3012.6010 (278)            |
| Space and water heating                     |                    |                                     | 9167.6401 (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               |                    |                                     | 7749.9823 (286)            |

## SAP 10 EPC IMPROVEMENTS

Plot 46

Current energy efficiency rating: B 91  
Current environmental impact rating: B 87

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 -143 kg (9.7%)

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

Potential energy efficiency rating: B 91  
Potential environmental impact rating: B 87

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):

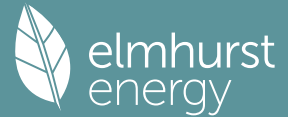
|                          | Current    | Potential  | Saving     |
|--------------------------|------------|------------|------------|
| Electricity              | £83        | £83        | £0         |
| Mains gas                | £553       | £553       | £0         |
| Space heating            | £426       | £426       | £0         |
| Water heating            | £149       | £149       | £0         |
| Lighting                 | £61        | £61        | £0         |
| Generated (PV)           | -£306      | -£306      | £0         |
| Total cost of fuels      | £330       | £330       | £0         |
| Total cost of uses       | £330       | £330       | £0         |
| Delivered energy         | 59 kWh/m²  | 59 kWh/m²  | 0 kWh/m²   |
| Carbon dioxide emissions | 1.5 tonnes | 1.5 tonnes | 0.0 tonnes |
| CO2 emissions per m²     | 14 kg/m²   | 14 kg/m²   | 0 kg/m²    |
| Primary energy           | 73 kWh/m²  | 73 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 Storey height Volume

# Full SAP Calculation Printout



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

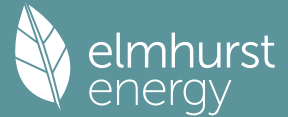
|                 |        |        |        |        |        |        |        |        |        |        |        |        |       |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| Wind speed      | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |       |
| 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>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     |                | 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, 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)                                    |             |                |               |                      |              |                   |                       | (34)         |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                |             |                |               |                      |              |                   |                       | (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                |              |
| E4 Jamb                                                          |             |                |               | 30.3000              | 0.0170       |                   | 0.5151                |              |
| E5 Ground floor (normal)                                         |             |                |               | 20.1900              | 0.0920       |                   | 1.8575                |              |
| E5 Ground floor (normal)                                         |             |                |               | 20.1900              | 0.0920       |                   | 1.8575                |              |
| E6 Intermediate floor within a dwelling                          |             |                |               | 27.8700              | 0.0010       |                   | 0.0279                |              |
| 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                |              |
| E10 Eaves (insulation at ceiling level)                          |             |                |               | 9.1000               | 0.0600       |                   | 0.5460                |              |
| E21 Exposed floor (inverted)                                     |             |                |               | 7.5100               | 0.3200       |                   | 2.4032                |              |
| E12 Gable (insulation at ceiling level)                          |             |                |               | 8.8500               | 0.0560       |                   | 0.4956                |              |
| E16 Corner (normal)                                              |             |                |               | 18.5000              | 0.0460       |                   | 0.8510                |              |
| E18 Party wall between dwellings                                 |             |                |               | 15.6600              | 0.0380       |                   | 0.5951                |              |
| E17 Corner (inverted - internal area greater than external area) |             |                |               | 5.6800               | -0.0880      |                   | -0.4998               |              |
| P1 Party wall - Ground floor                                     |             |                |               | 8.8300               | 0.0690       |                   | 0.6093                |              |
| E20 Exposed floor (normal)                                       |             |                |               | 7.9900               | 0.0690       |                   | 0.5513                |              |
| 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                |              |
| 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)       |             |                |               |                      |              |                   | 24.8859               | (36)         |
| Point Thermal Bridges                                            |             |                |               |                      |              |                   | 0.0000                |              |
| Total fabric heat loss                                           |             |                |               |                      |              |                   | (33) + (36) + (36a) = | 82.2773 (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 =                                           | 138.3079 | 137.8792 | 137.4589 | 135.4850 | 135.1157 | 133.3964 | 133.3964 | 133.0781 | 134.0587 | 135.1157 | 135.8628 | 136.6439 | (39) |
|                                                                     | 135.4832 |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |

# Full SAP Calculation Printout



|               |        |        |        |        |        |        |        |        |        |        |        |             |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.3076 | 1.3036 | 1.2996 | 1.2809 | 1.2774 | 1.2612 | 1.2612 | 1.2582 | 1.2675 | 1.2774 | 1.2845 | 1.2919 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.2809      |
| 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                                                  | 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 (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 (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 (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 (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 (63c)  |               |
| FGHRS                                                           | 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)  |               |
| 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)  |

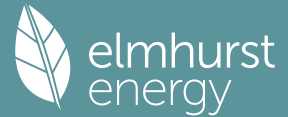
## 6. Solar gains

| [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                                                                         | 61.1516 | 61.3418 | 61.5293 | 62.4258 | 62.5964 | 63.4031 | 63.4031 | 63.5548 | 63.0899                   | 62.5964 | 62.2522      | 61.8963      |             |
| alpha                                                                       | 5.0768  | 5.0895  | 5.1020  | 5.1617  | 5.1731  | 5.2269  | 5.2269  | 5.2370  | 5.2060                    | 5.1731  | 5.1501       | 5.1264       |             |
| util living area                                                            |         |         |         |         |         |         |         |         |                           |         |              |              |             |
|                                                                             | 0.9978  | 0.9954  | 0.9875  | 0.9578  | 0.8725  | 0.7045  | 0.5344  | 0.5961  | 0.8505                    | 0.9773  | 0.9957       | 0.9983 (86)  |             |
| MIT                                                                         | 20.4724 | 20.5134 | 20.5865 | 20.6849 | 20.7643 | 20.8091 | 20.8196 | 20.8181 | 20.7858                   | 20.6796 | 20.5600      | 20.4684 (87) |             |
| Th 2                                                                        | 19.8349 | 19.8380 | 19.8411 | 19.8558 | 19.8585 | 19.8714 | 19.8714 | 19.8737 | 19.8664                   | 19.8585 | 19.8530      | 19.8472 (88) |             |
| util rest of house                                                          |         |         |         |         |         |         |         |         |                           |         |              |              |             |
|                                                                             | 0.9969  | 0.9936  | 0.9823  | 0.9394  | 0.8194  | 0.6022  | 0.4031  | 0.4604  | 0.7695                    | 0.9640  | 0.9936       | 0.9976 (89)  |             |
| MIT 2                                                                       | 19.2033 | 19.2586 | 19.3543 | 19.4900 | 19.5826 | 19.6364 | 19.6424 | 19.6446 | 19.6141                   | 19.4883 | 19.3323      | 19.2097 (90) |             |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |              |              | 0.1677 (91) |
| MIT                                                                         | 19.4161 | 19.4691 | 19.5610 | 19.6904 | 19.7808 | 19.8331 | 19.8399 | 19.8414 | 19.8107                   | 19.6881 | 19.5382      | 19.4208 (92) |             |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |              | -0.1500      |             |
| adjusted MIT                                                                | 19.2661 | 19.3191 | 19.4110 | 19.5404 | 19.6308 | 19.6831 | 19.6899 | 19.6914 | 19.6607                   | 19.5381 | 19.3882      | 19.2708 (93) |             |

# Full SAP Calculation Printout



## 8. Space heating requirement

|                                                                                | Jan       | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov           | Dec       |       |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|---------------|-----------|-------|
| Utilisation                                                                    | 0.9963    | 0.9925    | 0.9797    | 0.9330    | 0.8067    | 0.5834   | 0.3812   | 0.4372   | 0.7513   | 0.9588    | 0.9925        | 0.9971    | (94)  |
| Useful gains                                                                   | 746.9920  | 840.5745  | 938.7707  | 1003.5766 | 928.3798  | 658.3560 | 410.4922 | 434.6484 | 675.6411 | 755.9522  | 714.4033      | 711.2827  | (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                                                               | 2069.9339 | 1988.0891 | 1774.7327 | 1441.6146 | 1071.5776 | 678.0609 | 412.1766 | 438.0180 | 745.4546 | 1207.6759 | 1669.5082     | 2059.3307 | (97)  |
| Space heating kWh                                                              | 984.2688  | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824  | 687.6755      | 1002.9477 | (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |           |          |          |          |          |           |               | 4825.9864 |       |
| 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                                                              | 984.2688  | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824  | 687.6755      | 1002.9477 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |           |          |          |          |          |           |               | 4825.9864 |       |
| Space heating per m2                                                           |           |           |           |           |           |          |          |          |          |           | (98c) / (4) = | 45.6272   | (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                                                                                    | 984.2688  | 771.1297 | 621.9557 | 315.3874  | 106.5391  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 336.0824 | 687.6755 | 1002.9477  | (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)                                                                     | 1110.9129 | 870.3496 | 701.9816 | 355.9677  | 120.2473  | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 379.3255 | 776.1575 | 1131.9951  | (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 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                                                                            | 86.7308   | 86.5520  | 86.1028  | 85.0638   | 82.7922   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 85.1964  | 86.3910  | 86.7788    | (216)   |       |
| Fuel for water heating, kWh/month                                                                            | 267.2664  | 235.7957 | 249.2092 | 215.5836  | 210.3396  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 215.5415 | 232.6224 | 263.4168   | (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                                                                           |           |          |          |           |           |           |           |           |           |          |          | 5446.9373  | (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                                                                                      |           |          |          |           |           |           |           |           |           |          |          | 2666.0186  | (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                                                                          |           |          |          |           |           |           |           |           |           |          |          | 6231.4351  | (238)   |       |

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

|                                             | Fuel kWh/year | Fuel price p/kWh | Fuel cost £/year |        |
|---------------------------------------------|---------------|------------------|------------------|--------|
| Space heating - main system 1               | 5446.9373     | 3.6400           | 198.2685         | (240)  |
| Total CO2 associated with community systems |               |                  | 0.0000           | (473)  |
| Water heating (other fuel)                  | 2666.0186     | 3.6400           | 97.0431          | (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)  |

# Full SAP Calculation Printout



|                                       |            |         |                 |
|---------------------------------------|------------|---------|-----------------|
| 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                     |            |         | 221.0664 (255)  |

## 11a. SAP rating - Individual heating systems

|                                  |  |                                  |              |
|----------------------------------|--|----------------------------------|--------------|
| Energy cost deflator (Table 12): |  |                                  | 0.3600 (256) |
| Energy cost factor (ECF)         |  | [(255) x (256)] / [(4) + 45.0] = | 0.5278 (257) |
| SAP value                        |  |                                  | 91.4436      |
| SAP rating (Section 12)          |  |                                  | 91 (258)     |
| SAP band                         |  |                                  | B            |

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

|                                             | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1               | 5446.9373          | 0.2100                        | 1143.8568 (261)          |
| Total CO2 associated with community systems |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                  | 2666.0186          | 0.2100                        | 559.8639 (264)           |
| Space and water heating                     |                    |                               | 1703.7207 (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                          |                    |                               | 1470.5230 (272)          |
| CO2 emissions per m2                        |                    |                               | 13.9000 (273)            |
| EI value                                    |                    |                               | 86.9304                  |
| EI rating                                   |                    |                               | 87 (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>(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

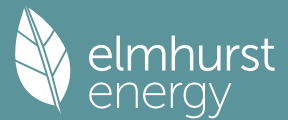
|                                                                                                    |                             |              |
|----------------------------------------------------------------------------------------------------|-----------------------------|--------------|
|                                                                                                    |                             | 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) |
| 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 | Openings | NetArea | U-value | A x U | K-value | A x K |
|---------|-------|----------|---------|---------|-------|---------|-------|
|---------|-------|----------|---------|---------|-------|---------|-------|

# Full SAP Calculation Printout



|                                                | m2       | m2      | m2       | W/m2K                | W/K     | kJ/m2K   | 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, 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) (28)...(30) + (32) + (32a)...(32e) = 30447.9100 (34)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 287.8691 (35)

| 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                                                          | 30.3000 | 0.0170    | 0.5151  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575  |
| E5 Ground floor (normal)                                         | 20.1900 | 0.0920    | 1.8575  |
| E6 Intermediate floor within a dwelling                          | 27.8700 | 0.0010    | 0.0279  |
| 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  |
| E10 Eaves (insulation at ceiling level)                          | 9.1000  | 0.0600    | 0.5460  |
| E21 Exposed floor (inverted)                                     | 7.5100  | 0.3200    | 2.4032  |
| E12 Gable (insulation at ceiling level)                          | 8.8500  | 0.0560    | 0.4956  |
| E16 Corner (normal)                                              | 18.5000 | 0.0460    | 0.8510  |
| E18 Party wall between dwellings                                 | 15.6600 | 0.0380    | 0.5951  |
| E17 Corner (inverted - internal area greater than external area) | 5.6800  | -0.0880   | -0.4998 |
| P1 Party wall - Ground floor                                     | 8.8300  | 0.0690    | 0.6093  |
| E20 Exposed floor (normal)                                       | 7.9900  | 0.0690    | 0.5513  |
| 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  |
| 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  |

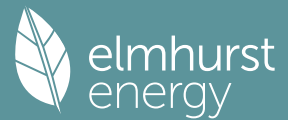
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.8859 (36)  
Point Thermal bridges (36a) = 0.0000  
Total fabric heat loss (33) + (36) + (36a) = 82.2773 (37)

| 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                                                 | 138.3079 | 137.8792 | 137.4589 | 135.4850 | 135.1157 | 133.3964 | 133.3964 | 133.0781 | 134.0587 | 135.1157 | 135.8628 | 136.6439 | (39) |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 135.4832 |      |
| HLP                                                                 | 1.3076   | 1.3036   | 1.2996   | 1.2809   | 1.2774   | 1.2612   | 1.2612   | 1.2582   | 1.2675   | 1.2774   | 1.2845   | 1.2919   | (40) |
| HLP (average)                                                       |          |          |          |          |          |          |          |          |          |          |          | 1.2809   |      |
| 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                                   | 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    | (64a)       |
| 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)        |

# Full SAP Calculation Printout



## 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 |           | Specific data<br>or Table 6b |           | 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                                                                         | 61.1516                   | 61.3418 | 61.5293 | 62.4258 | 62.5964 | 63.4031 | 63.4031 | 63.5548 | 63.0899 | 62.5964 | 62.2522 | 61.8963      |             |
| alpha                                                                       | 5.0768                    | 5.0895  | 5.1020  | 5.1617  | 5.1731  | 5.2269  | 5.2269  | 5.2370  | 5.2060  | 5.1731  | 5.1501  | 5.1264       |             |
| util living area                                                            | 0.9978                    | 0.9954  | 0.9875  | 0.9578  | 0.8725  | 0.7045  | 0.5344  | 0.5961  | 0.8505  | 0.9773  | 0.9957  | 0.9983 (86)  |             |
| MIT                                                                         | 20.4724                   | 20.5134 | 20.5865 | 20.6849 | 20.7643 | 20.8091 | 20.8196 | 20.8181 | 20.7858 | 20.6796 | 20.5600 | 20.4684 (87) |             |
| Th 2                                                                        | 19.8349                   | 19.8380 | 19.8411 | 19.8558 | 19.8585 | 19.8714 | 19.8714 | 19.8737 | 19.8664 | 19.8585 | 19.8530 | 19.8472 (88) |             |
| util rest of house                                                          | 0.9969                    | 0.9936  | 0.9823  | 0.9394  | 0.8194  | 0.6022  | 0.4031  | 0.4604  | 0.7695  | 0.9640  | 0.9936  | 0.9976 (89)  |             |
| MIT 2                                                                       | 19.2033                   | 19.2586 | 19.3543 | 19.4900 | 19.5826 | 19.6364 | 19.6424 | 19.6446 | 19.6141 | 19.4883 | 19.3323 | 19.2097 (90) |             |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              | 0.1677 (91) |
| MIT                                                                         | 19.4161                   | 19.4691 | 19.5610 | 19.6904 | 19.7808 | 19.8331 | 19.8399 | 19.8414 | 19.8107 | 19.6881 | 19.5382 | 19.4208 (92) |             |
| Temperature adjustment                                                      |                           |         |         |         |         |         |         |         |         |         |         |              | -0.1500     |
| adjusted MIT                                                                | 19.2661                   | 19.3191 | 19.4110 | 19.5404 | 19.6308 | 19.6831 | 19.6899 | 19.6914 | 19.6607 | 19.5381 | 19.3882 | 19.2708 (93) |             |

## 8. Space heating requirement

|                                                                                |                            |           |           |           |           |          |          |          |          |           |           |                 |
|--------------------------------------------------------------------------------|----------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|-----------|-----------|-----------------|
|                                                                                | Jan                        | Feb       | Mar       | Apr       | May       | Jun      | Jul      | Aug      | Sep      | Oct       | Nov       | Dec             |
| Utilisation                                                                    | 0.9963                     | 0.9925    | 0.9797    | 0.9330    | 0.8067    | 0.5834   | 0.3812   | 0.4372   | 0.7513   | 0.9588    | 0.9925    | 0.9971 (94)     |
| Useful gains                                                                   | 746.9920                   | 840.5745  | 938.7707  | 1003.5766 | 928.3798  | 658.3560 | 410.4922 | 434.6484 | 675.6411 | 755.9522  | 714.4033  | 711.2827 (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                                                               | 2069.9339                  | 1988.0891 | 1774.7327 | 1441.6146 | 1071.5776 | 678.0609 | 412.1766 | 438.0180 | 745.4546 | 1207.6759 | 1669.5082 | 2059.3307 (97)  |
| Space heating kWh                                                              | 984.2688                   | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824  | 687.6755  | 1002.9477 (98a) |
| Space heating requirement - total per year (kWh/year)                          | 4825.9864                  |           |           |           |           |          |          |          |          |           |           |                 |
| 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                                                              | 984.2688                   | 771.1297  | 621.9557  | 315.3874  | 106.5391  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824  | 687.6755  | 1002.9477 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | 4825.9864                  |           |           |           |           |          |          |          |          |           |           |                 |
| Space heating per m2                                                           | (98c) / (4) = 45.6272 (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                                             | 984.2688  | 771.1297 | 621.9557 | 315.3874 | 106.5391 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 336.0824 | 687.6755 | 1002.9477 (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)                              | 1110.9129 | 870.3496 | 701.9816 | 355.9677 | 120.2473 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 379.3255 | 776.1575 | 1131.9951 (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                                            |           |          |          |          |          |          |          |          |          |          |          | 79.6000 (216)   |

# Full SAP Calculation Printout



|                                                                                                      |          |          |          |           |           |           |           |           |           |          |          |            |        |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|----------|------------|--------|
| (217)m                                                                                               | 86.7308  | 86.5520  | 86.1028  | 85.0638   | 82.7922   | 79.6000   | 79.6000   | 79.6000   | 79.6000   | 85.1964  | 86.3910  | 86.7788    | (217)  |
| Fuel for water heating, kWh/month                                                                    | 267.2664 | 235.7957 | 249.2092 | 215.5836  | 210.3396  | 192.1791  | 186.1258  | 196.3413  | 201.5971  | 215.5415 | 232.6224 | 263.4168   | (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    | 7.0685    | 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)                                        |          |          |          |           |           |           |           |           |           |          |          |            |        |
| (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                                                                   |          |          |          |           |           |           |           |           |           |          |          | 5446.9373  | (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                                                                              |          |          |          |           |           |           |           |           |           |          |          | 2666.0186  | (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                                                                  |          |          |          |           |           |           |           |           |           |          |          | 6231.4351  | (238)  |

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

|                                             | Fuel<br>kWh/year | Fuel price<br>p/kWh | Fuel cost<br>£/year |        |
|---------------------------------------------|------------------|---------------------|---------------------|--------|
| Space heating - main system 1               | 5446.9373        | 5.6000              | 305.0285            | (240)  |
| Total CO2 associated with community systems |                  |                     | 0.0000              | (473)  |
| Water heating (other fuel)                  | 2666.0186        | 5.6000              | 149.2970            | (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                           |                  |                     | 330.5567            | (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               | 5446.9373          | 0.2100                        | 1143.8568                | (261) |
| Total CO2 associated with community systems |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                  | 2666.0186          | 0.2100                        | 559.8639                 | (264) |
| Space and water heating                     |                    |                               | 1703.7207                | (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                          |                    |                               | 1470.5230                | (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               | 5446.9373          | 1.1300                              | 6155.0391                  | (275) |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473) |
| Water heating (other fuel)                  | 2666.0186          | 1.1300                              | 3012.6010                  | (278) |
| Space and water heating                     |                    |                                     | 9167.6401                  | (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               |                    |                                     | 7749.9823                  | (286) |



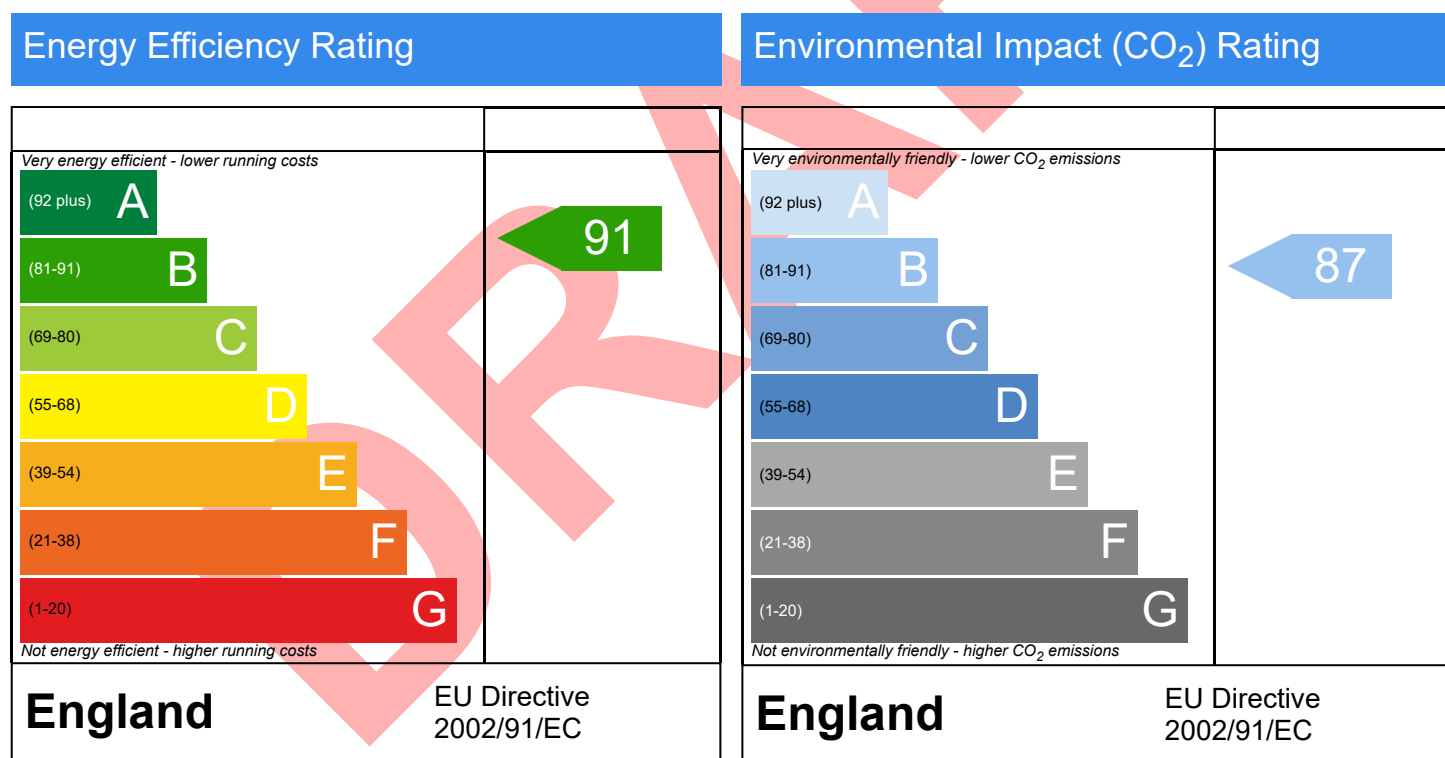
# Predicted Energy Assessment



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.